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THE FUEL RESEARCH BOARD.

RECENT events in the domain of scientific research, as distinct from industrial research, suggest that the great care which has been taken since the war to prevent, as far as possible, overlapping in scientific research, is not altogether the best policy. Prof. Gray, in his presidential address to Section A of the British Association, complained that the authorities who have taken over the supervision of scientific research are adopting the policy of too much concentration, and at the same meeting of the British Association in Bournemouth—and since then at the Iron and Steel Institute meeting in London—we have had a valuable object lesson, in the tactics of the Fuel Research Board, of the folly of concentration in regard to this class of research. Prof. Bone, Prof. Armstrong, and others have made a strong indictment against Sir George Beilby, chairman of the Fuel Research Board, that the policy of concentration is being carried to unwarranted lengths, and it has, indeed, developed into a secrecy, the rigour of which was not excelled in regard to the most cherished of our war secrets. In industrial research, all concerned in the particular trade are brought together for the common good, and all the brains in the industry are pooled for the purpose. The antithesis appears to hold with regard to the particular branch of scientific research covered by the Fuel Research Board. From the commencement it appears to have ignored the very scientists who were really responsible for bringing the Board into existence and for pointing out the best lines of investigation which the needs of our industries demanded. Since then a dead silence has fallen upon the doings of the Board, or, to be more precise, on what it intends doing. We agree with the view that unnecessary overlapping in scientific research should be avoided as far as possible, but having regard to the position created by the Fuel Research Board, no other alternative than to encourage overlapping seems available. So concentrated have its efforts become and so jealous is it, apparently, that nobody other than itself should touch research into fuel economy, that if, for instance, Prof. Bone has a promising student whom he wishes to set to work upon a special problem connected with fuel, and he asks for a grant for the purpose from the Department of Scientific and Industrial Research, he is told that he cannot have one, as fuel problems are being dealt with by the Board. Nevertheless, after two or more years' existence, admittedly difficult years, it has done absolutely nothing, and we are asked to wait another year or 18 months, when we are promised the possibility of results, but in what direction nobody knows. In consequence of the establishment of the Fuel Research Board, all private effort of the same kind has been abandoned, and the fuel problems which were agreed on all sides in 1915 as being of vital importance—as, indeed, they are—have since made no progress whatever, looked at from the practical point of view. As a result of the slowness of action of the Fuel Board, the British Association has revived its own Fuel Economy Committee; moreover, the Federation of British Industries has been driven also to take action, and it has appointed a Fuel Committee which will take up these problems on practical lines with the various industries, endeavouring to set up a standard and then showing to what extent particular firms in those industries fall short of that standard of efficiency. Further, the Iron and Steel Institute has quickly accumulated a fund of over £10,000 to investigate fuel and other problems in relation to the iron and steel industry. Meantime, it is said that the Fuel Board has spent something between £100,000 and £250,000, but no indication has been given of the programme which it intends to carry out or of the staff to whom this will be entrusted. An experimental

laboratory is being erected at Greenwich upon land belonging to the South Metropolitan Gas Co., and one reason given for the delay in getting to work is that the land was found to be of such a marshy nature that it was necessary—the Office of Works insisted upon it—to drive piles into it before a secure foundation could be obtained. There is such overwhelming dissatisfaction with the Fuel Research Board that it is high time some official statement was made as to the position. At present, Sir George Beilby, the chairman, cannot be "drawn" in any way.

Settling Up With Germany.

Under Article 296 of the Peace Treaty with Germany, it is provided that all persons in this country owing money to Germany on the outbreak of war shall now pay over what is due, with interest at the rate of 5 per cent. per annum, whilst German debts to this country are to be paid on similar terms. On the surface, of course, this arrangement seems fair and equitable, but, as is usual in all schemes arranged for the common good, there are bound to be hard cases. The Peace Treaty must now be regarded as an unalterable international instrument, and accepting, as we must, the position that our negotiators in Paris could only provide for what they regarded as the national interest, rather than that of any particular individual or individuals, there is little use in suggesting that modifications should be made. At the same time, the hard cases have a general interest, and we draw attention to two, as illustrating types which have, in fact, arisen. When the war broke out, and payments to and from Germany were prohibited, many firms on this side were left with large sums of money owing to Germany, and as prudent business men they should have put the amount of money in question aside in an easily realisable form. There were only two ways of doing this; one was to place it on deposit at the bank, in which case the rate of interest would have been something under 3 per cent., or it could have been invested in the business, in which case, nine times out of 10, the rate of interest or dividends earned would have been much higher. The only other alternative was to invest it, but even then, taking the average throughout the war, Government loans did not pay 5 per cent. Generally speaking, therefore, the latter course was probably not adopted. On the interest earned on the money, of course, the Government will have claimed income-tax, and if we take the case of those firms who earned 5 per cent. or less on the money owing to Germany and held back, they now have to face the unpleasant prospect of paying their German creditors a full 5 per cent. interest. Thus the war has placed a hardship on these firms, which we see no alternative but to grin and bear, although we cannot imagine the income-tax authorities refusing to adjust the income-tax when the circumstances are pointed out. An even harder case has come to our notice, in which the head of the firm, having kept the money in his business, subsequently joined the Army, and in his absence a loss was incurred, so that not only has he to pay his German creditors 5 per cent. upon money which earned nothing, but he has had to bear a loss in addition to that when, but for the war, he would have paid the money when due. The complaint in this class of case is that in order to make Germany pay a good rate of interest to her British creditors, British firms owing money to Germany are penalised, for it is recognised that the Peace Treaty could not have provided one rate of interest in our case and a higher rate in the case of Germany's debts to us. Hard cases, however, exist on the other side. Let us take the case of a firm to whom £50,000 was owed by Germany, and in respect of which bills had been issued—it is an actual case. When the war broke out the firm went to the Bank of England, and was made to pay 7 per cent. compound for the loan of the money on the security of the bills. That firm obviously stands to lose 2 per cent. on account of being prevented from collecting its debts, just as, on the other side, the British debtor is penalised through being prevented from paying his debts. A further hardship is threatened through the manner in which the whole question is being dealt with. Under the Peace Treaty, Government clearing houses are to be established in Berlin and London, so that the individual firms will not negotiate between themselves. These clearing houses have not yet been established; meanwhile, the interest is accumulating, and in the case of the British creditor mentioned, the Bank of England has refused to reduce the rate of interest from 7 per cent. compound to the 5 per cent. simple which is payable under the Treaty. Thus the longer the delay in the establishment of the clearing houses, the greater the hardship in these cases.

Swedish State Control of Electrical Energy.

After a lapse of five years the Swedish Government authorities have decided to take into consideration a report which was made in 1914 by a Committee appointed to examine the question of the supply of electrical energy. The majority of the Committee reached the conclusion that no weighty reasons existed for the adoption of measures for the purpose, by means of legislation or regulations applying to concessions, of bringing about an intervention in, or the control of, the economic conditions of undertakings for the electrical distribution of power. On the other hand, a minority of the Committee recommended that steps should be taken to regulate the prices of energy, and also suggested a new law, according to which a practical system of procedure for concessions should be introduced, with the right of the State to acquire electricity distribution works compulsorily and to fix charges for small consumers. The Minister of Justice, who has recently discussed the problem with the civil authorities, holds that the Committee came to a wrong conclusion when finding a State regulation of prices to be unnecessary. In his opinion, various circumstances, particularly the enormous increase in coal prices, show the importance of the supply of electrical energy being assured to the community at low prices, and it should, therefore, follow that the State should be afforded the possibility of obtaining full control over works and the power distributed from them. The question, however, is very complicated, and the draft of a law for fresh legislation in regard to concessions, as prepared by the minority of the Committee, would require reconstruction before it could be made the basis of a Bill. The Minister is, therefore, not disposed to deal with this part of the problem for the present, but the conditions of right as between undertakers and consumers are to be regulated by legislation, particularly in regard to the control of prices.

Ship-Wiring Regulations.

At last the long-expected "Regulations for the Electrical Equipment of Ships" are about to be issued by the Institution of Electrical Engineers, to which we are indebted for an advance copy—subject to revision. The "Ship Electrical Equipment Committee," including representatives of other bodies besides the Institution, was set up in May, 1916, and carefully studied the existing British and foreign codes of rules, which were all more or less discordant and inadequate, after which the new set of rules was drafted by a small Editing Sub-Committee in accordance with the principles laid down by the Committee. Thus a coherent and uniform style has been maintained. We are glad to see that all vitally important rules have been made mandatory, and definiteness has been aimed at throughout.

At the same time a number of Sub-Committees of the British Engineering Standards Association have been engaged on the standardisation of apparatus to comply with the new regulations, in complete co-operation with the Institution Committee.

The rules have been printed in a form really convenient for the pocket, and are set out to advantage by the use of suitable varieties of type.

That the new code will be eagerly welcomed we have no doubt; we shall review it in due course, and for the moment it will suffice to say that, judging by the vogue attained by the well-known "Wiring Rules" of the I.E.E., this ship-wiring code may confidently be expected to assume an authoritative position, and eventually to supersede all other British rules, and—it is hoped—to acquire an international standing, to the great advantage of all concerned.

THE PRINCIPLE OF RELATIVITY SIMPLY EXPLAINED.

By R. W. WESTERN.

(*Concluded from page* 389.)

So far we have been examining the experiment as it appears from O. Observers at the apparatus cannot do this; for them the existence of O is an hypothesis like any other. The conductor of the experiment is not cognisant of any such paths as M, B_1, M_2, or M, A_1, A_2 made out from O, of which he knows nothing. He measures what is before him—the lengths M A and M B, and finds them the same. The observer at O agrees as to M B, but when he notes that the conductor of the experiment crowds as many units into M A, so making them the same length, he can only conclude that the experimenter's unit of length contracts when he applies it to M A. The experimenter, of course, cannot tell if his measuring rod contract when placed in line with the direction of motion, or how much, for he does not know what his motion is or what direction it takes. Thus, granting an observer O_o at O, he must find that O_a the observer at the apparatus uses a different unit of length to measure distances at right angles and parallel to the line of motion between them, and that the latter is short, being in the ratio of $\sqrt{1-\beta^2}$ to the other. Now, there is no distinction between the observers O_o and O_a, except that we have supposed it is the last who conducts the experiment; thus we have only to suppose O_o to be conducting the same experiment at O, and the same reasoning applies also to the units of length he employs.

Thus O_o finds O_a's unit of length, in the direction parallel to the line of motion, shorter than his own, being in the ratio of $\sqrt{1-\beta^2}$ to his, and O_a also finds O_o's unit shorter in that direction than his own, being in the same ratio $\sqrt{1-\beta^2}$ to the unit he uses himself. The units of distance parallel to the line of motion, therefore, undergo the same change as the unit of time.

Since the clocks of A and B as well as the apparatus of O_o and O_a fulfil their respective functions notwithstanding these variations in the units of time and of length, mechanical law continues to apply. Consequently the units of force, acceleration and mass, &c., undergo consonant variations, the character of which may be easily ascertained by consideration of dimensions. As we have seen, each observer estimates that every one in uniform rectilinear motion with respect to himself, employs a unit of time shorter than his, being his own multiplied by the fraction $\sqrt{1-\beta^2}$, and a unit of length the same as his own in directions transverse to the line between them, but in the direction parallel to it smaller than his own, being again in the ratio of $\sqrt{1-\beta^2}$ to it. Hence, the unit of velocity will be the same as his own in the direction parallel to the line of motion, but for directions transverse, in that ratio

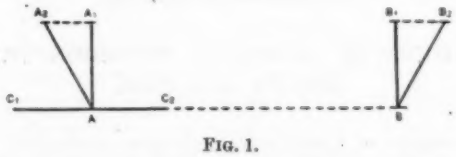


Fig. 1.

to his as the unit of time stands; that is to say, each observer will estimate that the other measures velocity in smaller units than his own in directions transverse, being in the ratio of $\sqrt{1-\beta^2}$ to his. Thus, A and B, fig. 1, are not in disagreement regarding their velocity relative to each other in the line which joins them, for each measures this velocity in the same units; but regarding velocities at right angles they are in disagreement, as may be seen from their measurements of the velocity of light already described. To A it appears that B measures this velocity in units too small, crowding as many in a velocity maintained from B to B_1 as would suffice to measure a velocity that would reach from B to B_2 in the same time. By further consideration of dimensions, we find in like manner that the units for acceleration will be $(1-\beta^2)$ transverse, and $\sqrt{1-\beta^2}$ parallel.

To obtain the units in which mass is measured, it will suffice to find in any single case what they must be in order to conform with the laws of mechanics. Now any difference in units employed by observers arises from a relative velocity between them, which we have denoted by V, and as momenta in directions transverse to the line of that velocity are independent of V, such momenta must be the same for both observers, notwithstanding differences in the units employed for measurement of time and of mass respectively.

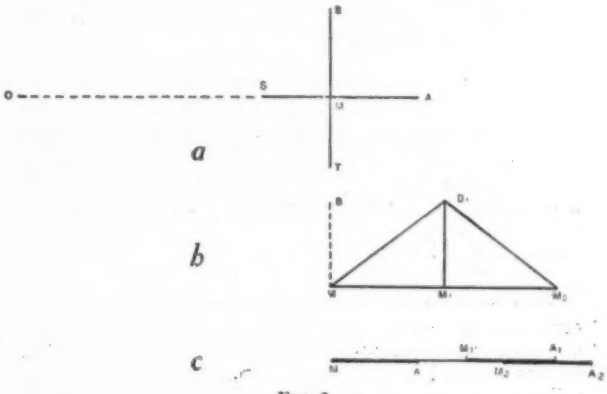


Fig. 2.

So if we conceive an experimenter, such as O_a, receiving a body discharged from O_o as he passes, the momentum of that body in the transverse direction must be the same for both. Since each estimates the unit in which the other measures velocity to be small, being in the ratio of $\sqrt{1-\beta^2}$ to his own, each must estimate the unit in which the other measures mass to be large, and in the ratio $1/\sqrt{1-\beta^2}$ to his own. Supposing O_a, as the body reaches him, to swing it round through an arc of 90° without loss of energy, so that it come to move in a line parallel to that of his motion relative to O_o; conservation of energy requires that—

$$M_t\, v_t^2 = M_p\, v_p^2,$$

whence

$$M_p/M_t = v_t^2/v_p^2.$$

The units in which velocities squared are measured being in the ratio $1-\beta^2$, the ratio in which the masses are measured will be $1/(1-\beta^2)$, and the unit for transverse mass being $1/\sqrt{1-\beta^2}$, as already found, the unit for longitudinal mass, or mass parallel to the line of relative motion, will be $1/(1-\beta^2)^{11}$. Hence, each observer estimates the unit in which the other measures mass as large, being in the ratio $1/\sqrt{1-\beta^2}$ to his own in respect to transverse motion, and $1/(1-\beta^2)^{11}$ in respect to parallel motion, and each observer, by thus imputing to the observed the use of large units in the measurement of mass, finds that he (the observed) makes his estimate of masses smaller than, in fact, they are. Thus an observer from whom we were separating or approaching at a very high speed (making $1-\beta^2$ small) must needs ascribe to our masses large magnitudes. Conversely, a body such as an electron, moving with respect to us at many thousands of miles per second, must be endowed, for any action affecting us, with a vast augmentation of mass. The units in which force is measured by each observer in the estimation of the other may be obtained by a like consideration of the dimensions involved.

In the following table the ratios in which the several units stand to each other, as already ascertained, are set out :—

Unit of—	The ratio of the observed's unit to the observer's unit. Transverse.	Parallel.
Time	$\sqrt{1-\beta^2}$	$\sqrt{1-\beta^2}$
Length	1	$\sqrt{1-\beta^2}$
Velocity	$\sqrt{1-\beta^2}$	1
Acceleration	$1-\beta^2$	$\sqrt{1-\beta^2}$
Mass	$1/\sqrt{1-\beta^2}$	$1/(1-\beta^2)^{1\frac{1}{2}}$
Force	$\sqrt{1-\beta^2}$	$1/(1-\beta^2)$

The ratio of the unit employed by the observed to that employed by the observer is small when what is being measured by the observed is small to the observer. This is the case with time, and with lengths parallel to the line of relative motion as described ; and when the ratio is large, as in the case of mass, the quantity in question is large to the observer. Thus, any body moving in respect to us at great speed would for every purpose of ours be thinner than if at rest, and of greater density.

That property of material which we designate mass being thus modified, all quantities involving mass undergo a corresponding change. The most significant is that introduced into the interpretation of the quantity we call energy. The energy of translation of a body moving with velocity v is ordinarily expressed by

$$\mathrm{M}\int_0^v v\,dv,$$

in which v represents its velocity of translation in respect of ourselves, and M is its mass. The theory of relativity replaces M by $\mathrm{M}_0/(1-\beta^2)^{\frac{1}{2}}$, in which M_0 is the mass of the body at rest, so that, remembering $\beta = v/c$, we have

$$\mathrm{E} = \mathrm{M}_0\int_0^v\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}} v\,dv = \frac{\mathrm{M}_0\,c^2}{\sqrt{1-v^2/c^2}} - \mathrm{M}_0\,c^2.$$

Here we have the energy of a body presented as the difference of two immense quantities, the first of which depends upon v, and the other is independent of it. If M_0 be the mass of a bullet and v the muzzle velocity, the difference is one not of millions, but billions, of foot-lb. The interpretation of this expression is significant of much. The modification we have been induced to make in the estimate of mass by considering the behaviour of light, imports the velocity of light as a factor into the constitution of matter, and makes the total energy of matter an essential component in estimating its energy of translation. For it is difficult to doubt that in this expression we are confronted with the whole energy of the body less its internal energy, comprising electrons moving, as we have reason to believe, with velocities like that of light. Allowing for a constant which enters into both, and cancels out when their difference is taken, we have $c^2\,\mathrm{M}_0/\sqrt{1-\beta^2} + \mathrm{K}$ for the total energy of the moving body and $\mathrm{M}_0\,c^2 + \mathrm{K}$ for its internal energy when at rest.

Seeing that M_0 is the mass of the body at rest, and $\mathrm{M}_0/\sqrt{1-\beta^2}$ is its transverse mass when in motion ; it appears that the extra energy of a body when given energy of translation is wholly accounted for by the augmentation of its mass, due to the velocity of translation. Thence we may infer that the mass of a body at rest is accounted for by augmentation of its mass, due to the velocity of its parts, save in so far as this inference is affected by the constant K, which may contain some nucleus of mass not due to motion at all. The nature and amount of K has yet to be discerned. It contains all there is in mass which is not energy, and may be zero. In that case the total energy of a body is measured by $\mathrm{M}_0/\sqrt{1-\beta^2}$ its transverse mass, and its mass at rest is the measure of its internal energy.

Reverting to $\mathrm{M}_0\,c^2\{1/\sqrt{1-\beta^2}-1\}$, the expression for the energy of translation, we have by expansion :—

$$\mathrm{M}_0\,c^2\left\{\frac{1}{2}\frac{v^2}{c^2} + \frac{3}{8}\frac{v^4}{c^4} + \frac{15}{48}\frac{v^6}{c^6} + \&c.\right\}$$
$$= \mathrm{M}_0\left(\frac{v^2}{2} + \frac{3}{8}\frac{v^4}{c^2} + \frac{15}{48}\frac{v^6}{c^4} + \&c.\right),$$

showing that the ordinary formula for the energy of a moving body is but a first approximation to the truth.

ADJUSTING METALLIC BRUSHES ON ROTARY-CONVERTER RINGS.

By FREDERICK MURGATROYD.

It is well known that the correct adjustment of the spring pressure on brushes is most important, but more than ordinary care should be exercised where a number of *metallic* brushes are running in parallel on a slip-ring, as is often the case with rotary converters.

To obtain an equal distribution of the load among the brushes, it is first of all necessary that each brush should exert the same radial pressure on the ring. This radial pressure is the sum of the spring pressure and the radial component of the weight of the brush itself. With graphitic brushes, the latter is generally negligible, but this cannot be said of metallic brushes which, being usually large on rotary-converter rings, weigh, on the average, about ¾ lb. Referring to the sketch, if—

W = weight of brush in lb.,
θ = angular displacement of brush from the vertical,
P = radial pressure of spring,
K = radial pressure of brush on the ring,

then $\mathrm{K} = \mathrm{P} + \mathrm{W}\cos\theta$,
or $\mathrm{P} = \mathrm{K} - \mathrm{W}\cos\theta$.

Having decided on a value for the constant K, the procedure then is to calculate P for each brush by means of the last equation. The diagram below shows how simple this is. At the top the value of W cos θ is W, at the bottom —W, at 30° roughly ⅞ W, at 60° it is W/2, whilst at 90° the value is zero.

It will be asked, "Is such a refinement necessary?" The answer is that in certain cases of trouble where the complaint has been sparking and quick wear of brush, the

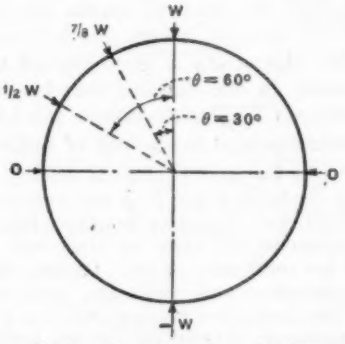


Diagram of Radial Components of Pressure Due to Weight of Brush.

cause has been proved to be irregular brush pressures, namely, that P has been made constant all round instead of K. In these cases, excellent operation has resulted from adjusting P to make K constant on each brush. Irregular brush pressures lead to overloading of particular brushes, and it should not be forgotten that brush wear tends to increase as the current density increases.

GERMAN BUSINESS METHODS IN SOUTH AMERICA.

The subject of export credits occupies such a prominent position that no apology is needed for referring to the question as applied to Germany in the past. It may be urged that it is useless to discuss the pre-war period. This would be a short-sighted policy, because there is no doubt that Germany will rise again industrially, if not in other respects, and notwithstanding the changes in the international situation, it will be the old Germany, embittered and sharpened by the experience and burdens imposed by defeat. When we hear that the Teutonic oversea banks are already prepared to finance a commercial army of small manufacturers and merchants who propose to

proceed to the principal countries in South America for the establishment of agricultural, commercial, and industrial colonies, provided these States will consent to receive the enormous army which is reported to be in prospect, the theory that Germany will rise again seems not to be devoid of foundation.

Let us come, however, to the question of credits, and in dealing with this problem, it should be understood that the first part of this article applies to German trade in general, and the second part to the engineering industry.

It has always been assumed in Great Britain that a very large measure of the success which characterised the great expansion of German oversea trade in former years was due to the circumstance, as was contended, that the Teutons made a practice of granting specially long credits, particularly in the South American markets. This argument was given apparent confirmation in the reports of British Consuls in different parts of the world, and it has, therefore, been accepted in many cases as representing the true and actual state of affairs. Of course there is trade—and trade. In pre-war days the Germans accepted many orders both direct and through their branches or agents for manufactures of multifarious kinds, and of such infinitely small values, that it is probable no British firm would have been prepared to entertain the idea of executing such trivial orders unless payment had been made in advance. Naturally, large orders were also welcome, and were executed. It may have been, or it may not have been, a foolish policy on the part of British firms to refuse to handle small business. But this practice well answered the purpose of the Germans in their export trade to the United States and the whole of South America, in so far as concerns the acquisition of business or customers, and the total value of the small orders booked by Germany for the destinations in question must have formed a fair percentage of the aggregate value of the export trade of that country. In the United States the German credits were short—30 days or three months at the outside. But the number of overdue accounts which had to be collected by the branches in the United States of German banks—some of them mere debt-collecting offices—used to be very considerable.

On the other hand, the pre-war terms in the South American countries were from three to four months. Exporters dated bills from the date of the invoice, and sent them out to their agents or the banks to secure the acceptance of customers. It is important to note, however, that only the very best firms met the bills on maturity. It is here, we think, that the question of long-term credits comes, or, rather, came, into consideration. Failing to obtain payment when the bills fell due, the bills were renewed and interest charged at rates of from 6 to 9 per cent., and further renewals frequently had to be made in consequence of the difficulty experienced in recovering the debts. It was this practice of prolonging bills because customers were either unable or unwilling to pay which eventuated in the reputation which the Germans gained for granting extended credits, whilst they themselves had to borrow money or get the bills discounted at home. It used to be no uncommon habit for the services of the German Consuls to be requisitioned in order, if possible, to bring pressure to bear upon "bad" customers to meet their liabilities.

Apart from cases in which special arrangements were made, the German conditions for the supply of machinery and plant in the South American market in the pre-war period were: Payment of one-third of the value of the transaction on the placing of the order; one-third on the completion of the order at maker's works; and one-third at the port of destination in exchange for the bills of lading.

The big electrical firms, when not knowingly in competition with foreign rivals, used to send out to South America fairly complete specifications and descriptions, both in Spanish and German, of the machinery and plant which they were prepared to supply. The boilers, engines, dynamos and exciters, alternators, motors, transformers, switchboards, cables and overhead network, switches, cut-outs, and fuses, and, in fact, all the component parts of a complete installation were set forth in detail, and each priced separately, the prices being for the machinery and plant at maker's works. The totals were then given, with additions for sea-tight packing and cost of rail transport to Hamburg f.o.b.—whilst the cubic dimensions of the cases were specified, so that the freight charges from Hamburg could be ascertained by the prospective customers. In fact, so detailed were some of the specifications and descriptions, that they frequently occupied type-written foolscap sheets ranging from 20 even up to 100 sheets. The specifications and descriptions were sent out in duplicate or triplicate to the German branches or representatives in South America, and, in some cases, the discounts allowed to these branches on the different items in a complete installation amounted to from 20 to 40 per cent. It was, therefore, an easy matter for the branches, when they themselves were in direct negotiation with likely customers, to accommodate their quotations to circumstances, as, for instance, in the event of the customers having received competitive offers from foreign firms; in some cases the prices in one copy of the specification would be left blank, and be filled in by the transmarine branch in South America.

The electricity supply companies in South America, owned or controlled by Germans, or in which they have or had a large interest, have always been active organisers and promoters of the use of Teutonic machinery and plant, and their engineering representatives have not failed to cultivate sales and complete installation business in districts distant from the actual limits of supply from the generating stations. When it became impossible to procure deliveries from Europe owing to the blockade, the Germans simply made purchases from the United States until the latter entered the war; and then the Teutons endeavoured to obtain plant from Spain. In the meantime the Japanese have gained a footing in electrical manufactures, particularly in Argentina, and now the contest in South America promises to become keener than ever in the future.

THE SHIPPING, ENGINEERING, AND MACHINERY EXHIBITION.

Originally it was intended to hold this Exhibition in the autumn of 1914. Rudely interrupted, however, by the outbreak of war, within a few weeks of the date fixed for the opening, the scheme seemed at one time to have little chance of maturing. But as soon as the Armistice was signed the promoters took steps to carry out the undertaking, and it is now being held at Olympia, London.

The Exhibition has not been designed with the idea of impressing upon the nation the magnitude so much as with the variety of the interests involved in matters affecting the shipping and engineering interests, and visitors during the three weeks the Exhibition will be open will realise how greatly the well-being of the nation is dependent upon the efficient maintenance of our Mercantile Marine. While British firms naturally predominate among the 350 exhibitors who are represented, the Exhibition is of an international character (with the exclusion, of course, of all recent enemy nations); and exhibits of an interesting character will be found from Allied and neutral countries. For the first time in the history of Holland, the Netherlands Government has made a pronounced effort to bring before the business world the resources of that interesting and productive country. In the early stages of the Exhibition, prior to the war, a Royal Commission was formed for the purpose of getting together a collective exhibit of Dutch shipping (Naval and Mercantile), shipbuilding, and engineering, and it is not too much to say that the Dutch section is one of the most attractive and successful commercial enterprises ever undertaken in London by a foreign Government.

In his speech opening the Exhibition, on Thursday morning, last week, the Right Hon. Lord Weir of Eastwood said that in the task of reconstruction no channel should be ignored, and no element of fair business could be omitted. Advertising was a channel which led to orders, and every-day advertising was being recognised as essential to sound business.

Many of the exhibits demonstrate the advances made in war time, and the general public will also find much of interest. The Exhibition will remain open from 11 a.m. to 9 p.m., until October 17th.

It is said that the first two days'booking of orders showed promise of very good business, but it is to be feared that the lamentable railway strike will be painfully felt. Perhaps the adverse effect might be somewhat counteracted by deferring the closing date of the Exhibition; but this would necessarily depend on what arrangements could be made for extending the lease of the hall, which is required for other purposes next month. Unfortunately, the rash decision of the railway-workers' leaders promises to upset the calculations fostered by the opening day's promise of a record show.

The educational side, apart from that afforded by an inspection of the exhibits, has also been provided for. A kinematograph theatre has been established in the Exhibition, in which films will be displayed of shipbuilding and other commercial interest. Facilities are also afforded to employés, students, and others to visit the Exhibition at much reduced rates, and the large number of applications received for these tickets is an excellent augury for the success of the Exhibition from this standpoint. Official visits have also been arranged by many engineering institutions and associations.

Probably no previous exhibition of this character has created so much interest in other parts of the world. The management issued 6,000 invitat ons to foreign, Colonial, Indian, and other buyers, many of which have been accepted, while letters have been received from all parts of the globe from those who are unable to visit the Exhibition, asking for copies of the catalogue and other particulars.

Lord Weir, speaking at the inaugural luncheon which followed the formal opening of the Exhibition, said it would be worse than folly to disguise the gravity of the position of British industry to-day. It was no exaggeration to compare it with the emergency of August, 1914. Unity was required to-day, he said, to defeat the forces of unrest and irresolution that were paralysing our industrial enterprise and development, on which depended the livelihood and prosperity of our people.

Those whom we elected to govern must decide either for a policy of improvement built on existing foundations, or for one of demolition and experiment. Either they must stand for evolution or revolution. In the latter event they must visualise a plan for running the country without the wage and capital system, clearly and definitely enough to warrant them in subordinating the happiness and contentment of this and the next few generations to the achievement of something which to-day no one dared term other than fantastic. If they appreciated the fantastic impracticability of this, then let them equally clearly say so, and at the same time decline to allow that influence to affect them in their plan.

The employer must adopt a practical policy of domestic conference with his workers, or their chosen representatives, to explain his schemes and changes, and thereby secure co-operation and eliminate distrust and suspicion. Equally must the Trade Unions revise their attitude, and accept the responsibility which the progress of economic thought imposed upon them.

We commence below a review of the electrical exhibits.

Messrs. Belling & Co., Montague Road, Upper Edmonton, London, N.18. This firm's reputation, since it commenced the manufacture of electric labour-saving appliances for the home seven years ago, is too well known to need any eulogising. The fact that the total sales to the present time of all types exceed 150,000 speaks for itself. We cordially agree that "It's the little things that tell" when dealing with domestic appliances, and a feature of all Belling apparatus is the interchangeability of the connectors for attaching them to the electric supply. Standardised centres and diameter of pins have been adopted throughout, enabling any appliance to be attached thereby; either split or solid pins can be used, the contact being obtained by the special design of the socket inside the connector. There are no parts more liable to wear and tear than connectors, being continually taken on and off, hence first-class mechanical design, combined with perfect electrical contact, is essential. A great benefit to the user is that additional connectors can always be ordered with the sure knowledge that they will fit all appliances.

This firm is now able to deal with inquiries concerning electric washing machines, a recent addition to its series of labour-saving devices, and it will also shortly be in a position to supply small electric motors suitable for attaching to existing sewing machines and other domestic appliances requiring small power to drive them.

The Belling system of high-efficiency interchangeable electric fire bar consists in supporting a red-hot spiral wire as far as possible in free air, on one side only and away from a bar of fireclay, which latter acts as a reflector throwing the heat forward. The dimensions of the bars are: 10.75 in. long, 1.75 in. wide, and ⅝ in. thick with fixing centres 10 in. apart. Fig. 1 illustrates a strong portable heater which can be connected to any lampholder and placed anywhere where instantaneous heat is desired; the heating unit is protected by a stout wire guard, which can be easily removed to clean the reflector. The parabolic reflector is of polished copper, can be adjusted to any angle, and when horizontal may be used for boiling water, &c. It has a cast-iron base, is finished in black and copper, the dimensions being: height 18 in., width 12 in., and weight 7.5 lb. with a full-on consumption of about 0.5 unit per hour.

Fig. 2 shows an attractive design of electric kettle suitable for the dining or drawing room; it is finished in nickel plate with a cane-covered handle, which always remains cool. It consumes just over 0.5 unit per hour, and has a capacity of two pints, which it boils in 10 minutes; it can be connected to any lampholder, and with electricity at 1d. per unit will boil eight times for 1d. and *pro rata*. Fig. 3 is a view of an electric cooker with which, it is claimed, every cooking operation can be carried out. There are two multiple-heat rings

Fig. 1.—The "Sunflower" Heater.

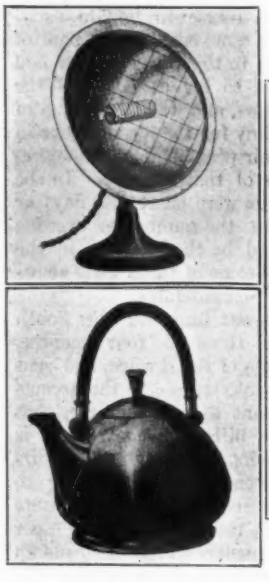


Fig. 2.—The "Beehive" Kettle.

Fig. 3.—The "Modernette" Cooker.

on the hob; the oven is 16 in. high by 14 in. wide, heated by two multiple-heat elements, one at the bottom and one at the top, the latter one being suitable for grilling purposes. The overall height of the cooker is 36 in., overall width 24 in., and the top hob is 24 in. by 15 in.; it weighs 80 lb., and has a total loading of 4 kw. There are altogether eight exactly similar 500-watt spirals on this cooker, fitted into four interchangeable, 3-heat, 1-kw. heating elements. A plate warmer is provided on the left and a useful shelf below; it is recommended that a twin-bar kettle, for boiling water quickly, be used with this cooker. The outfit is supplied complete, finished in planished steel and nickel fittings, with two enamelled trays, two rod shelves, a solid shelf, grill pan and grid, two spare spirals, and two spare insulators.

Fig. 5 shows a water heater which aims at overcoming the difficult problem of the successful heating by electricity of the bath water. The container is made of solid copper, tinned inside and polished outside; it is fitted with two twin-bar immersion heaters which raise the 8 gallons of water contained in the tank to boiling point in about one hour. This gives a bath, when mixed with some cold, of 15 to 20 gallons of hot water, which with electricity at 1d. per unit would cost 4d. to prepare. The heater is finished in polished copper, and its dimensions are: diam. 11 in., height 24 in., weight 22 lb., loading 4 kw., and capacity 8 gallons. It is necessary that this heater be efficiently earthed, for which purpose a special terminal is provided. It should be connected to the supply mains by means of a wall plug and socket controlled by a double-pole switch; a tell-tale lamp, with fuse, should be connected across the wall sockets so that when the heater is

"on" the lamp is alight. The switch should, of course, be "off" when the bath is in use.

A recently perfected electric suction cleaner is seen in fig. 4, which should be a most useful addition to any home. No exertion is required to operate it, a flexible cord only needs to be attached to any convenient lamp socket, and it glides easily over the floor without injury to the carpets or rugs. The whole outfit, which weighs only 9.5 lb., is entirely of British manufacture, and the cost of operation, it is claimed, is only about 0.5d. per hour Figs. 6 and 7 show electric immersion heaters; the first for converting existing gas or spirit-heated kettles, tanks, and similar appliances to electric heat-

Fig. 4.—An Electric Suction Cleaner.

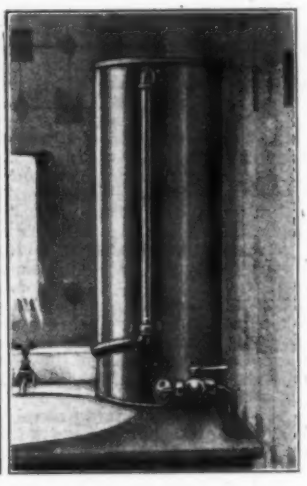
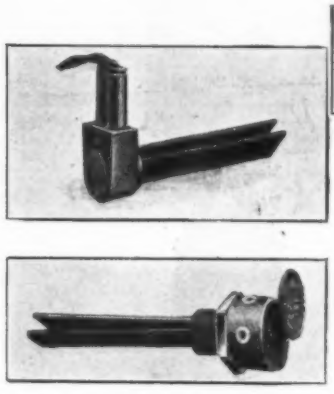


Fig. 5.—A Bath-water Heater.

ing. It consists of two tined copper blade heaters fitted into a brass terminal box, connector pins and sockets, flexible cable, packing ring, and a screwed gland for sweating into the utensil. The length of the blade is 6.25 in. and the consumption about 1.5 units per hour. The second heater is for use to heat water, oil, &c. The heating blades, 8.75 in. long, are of tinned copper; the brass gland for screwing into the tank or cylinder is 1.5 in. barrel size, 11 threads per in. Two terminals are fitted inside the head of the gland with inlet bushes for the wires. The consumption of this heater is about 2 units per hour. Figs. 8 and 9 show respectively horizontal and vertical air warmers. This is a reliable low-temperature heating appliance made in cast iron with stove black-enamel finish. The dimensions of the former are: length 15.5 in., width of base 6.5 in., depth 4.5 in., weight 12 lb. with a consumption of 0.5 unit per hour. The vertical type is fitted with two switches and weighs 60 lb.; its width is 12.25 in., depth 7 in., and height 30 in., the consumption being 1.5 units per hour. These heaters can be used in any position without risk of fire, they are claimed to be proof against shock or damage, and if placed in damp positions the switches can be fitted separately in a dry place.

The Aster Engineering Co. (1913), Ltd., Wembley, Middlesex. This firm is a pioneer in the manufacture of direct-coupled sets in this country, there being approximately 35,000 engines in use at the present time. "Aster" sets furnished a large portion of the searchlight barrage round London and provincial towns. The type 88 6.F.N. engine has been installed in destroyed power stations in Belgium, also as a power unit in the Inland Water Transport workshop barges. This engine was developed just previous to the war for petrol-electric rail-car propulsion. A very large number of Aster 10-, 18-, 25-kw. sets have been installed in camps all over Ireland and a considerable number in Great Britain, where they have given successful service. All the generating sets consist of high or medium speed engines direct coupled to generator on one bedplate. Generating set, type 12 C.M., includes a four-cycle single-cylinder petrol engine, air cooled by means of a fan. The engine and dynamo are cast in one piece, the switchboard being mounted by means of brackets on the dynamo frame. This set is semi-automatic inasmuch as it is furnished with an electric starter and requires only a push of the button to put it into operation. The set is also provided with batteries, and the engine automatically stops itself when these are charged. This type of generating set is eminently suitable for medium-size country house lighting and for farms, and is sold at competitive prices. The set is fitted with several patents, which increase its efficiency and enhance its value. Type 6 P.Z. is a high compression engine on the semi-Diesel two-cycle principle; it will run on heavy oils, such as Scotch shale, Russian naphtha or Admiralty fuel oils, and is an ideal engine for larger country house lighting, farm implement driving, &c. This firm also supplies arc-welding sets, one of which is shown in fig. 10; marine sets for ship's lifeboats, &c., from 7 to 110 b.h.p., auxiliary lighting sets, direct-coupled pumping sets, &c.

The London Electric Firm, Brighton Road, Croydon, exhibits searchlight projectors and gear. The 20-in. projector is an up-to-date high-class searchlight for commercial purposes, built generally on the lines of naval patterns, but not quite so elaborate. It is provided with a silvered-glass parabolic mirror, combined auto and hand-feed lamp and a flashing shutter. The lantern barrel is flush finished, the stiffening angle rings at each end being inside, and the mirror, front glass and shutter mountings are secured with a very neat and facile fixture. The shutter is arranged to interchange with a diverging lens when required. The lantern is balanced horizontally, and is supported by arms formed of steam tube secured to a turntable at their lower ends, the turntable being arranged to rotate on the fixed cylindrical base. The lamp is fitted with hand and automatic non-disengaging feed, which operates entirely automatically, but at the same time can be adjusted by hand control if desired, without the necessity for change-over levers or clutches. It



Figs. 6 and 7.—Immersion Heaters.

Figs. 8 and 9.—Air Heaters.

is robust in construction, and in this particular class of searchlight the working parts are doubly enclosed, as the lamp complete, with its supports and focus gear, is mounted in a lamp box built integral with the lantern body. The beam of light may be trained, elevated or depressed, and can be pointed vertically, and the lamp will work as satisfactorily at extreme as at normal angles. A 20-in. Suez Canal projector is the type of searchlight now universally used for night navigation in the Suez Canal. It is somewhat similar to the above (the lamp being identical) but less elaborate, generally, in design. The lantern and supporting arms are arranged to lift off the base for stowing below when not wanted in use. The mirror used for this projector is of Parsons patent split variety, and normally gives the flat beam required for picking up the

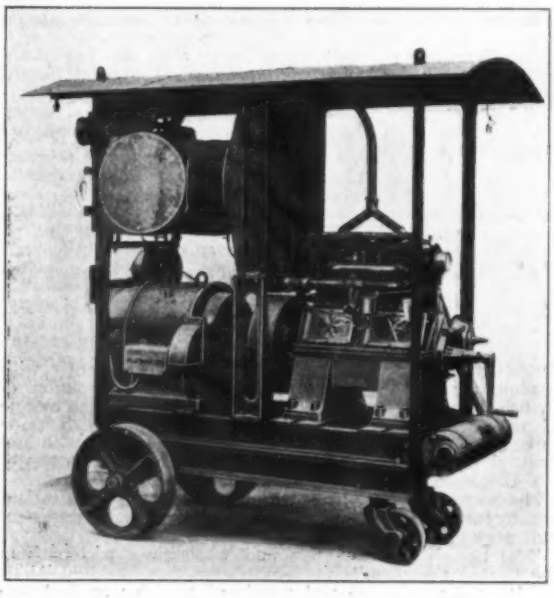


Fig. 10.—A 12-kw. Portable Arc-welding Set.

buoys. When the lever at the rear is operated, the position of the two halves of the mirror (which are hinged together) is slightly modified, and the beam is split up into two sections, with a well-defined dark section in the centre. This

obviates the pilot of an on-coming ship being dazzled by the light, and does not detract from the effective illumination of the buoys. This arrangement can be modified as to light and dark angles, and therefore lends itself for other uses. A 16-in. pilot house searchlight is made of brass and gunmetal (practically) throughout to meet the demands of shipbuilders and owners for "all brass" searchlights of this class. The outfit is mounted on the top of the wheel-house, and the control gear projects downwards into the cabin, within easy reach of the pilot, who can direct the light as required. The lamp is of the auto and hand-feed pattern, and the mirror is usually of the standard parabolic silvered-glass type. A 14-in.

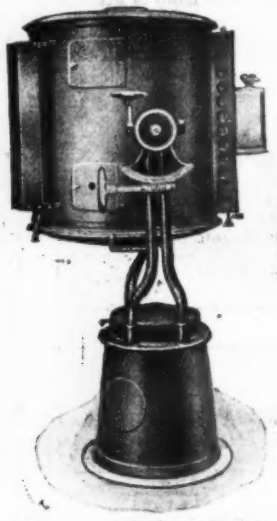


Fig. 11.—A "London Electric" Searchlight.

inexpensive projector outfit would be fitted with a silvered *metal* reflector and hand feed lamp, and is made at a competitive price. It is extremely useful for many purposes where a high-power searchlight is not needed, and is conveniently mounted on the bridge of a vessel. The 90 c/m lamp is a combined automatic and hand-feed lamp with non-disengaging gear, but motor controlled; the feed gear is differential, *i.e.*, the motor both opens and closes the arc, and in addition there is a separate series coil provided for striking purposes.

The small winches shown are used for lowering engine room and mast head electric lamps, and may be employed in conjunction with or without contact suspension gears—the latter make electrical contact with the supply and also take the weight of the lamp off the rope. The larger winches are supplied in 2.5, 5 and 10-cwt. sizes, and are intended for general lifting purposes. The above are suitable not only for use on shipboard but in docks, shipyards, factories, &c.

This firm manufactures every variety of this equipment both large and small, and for hand control, also for distant electric, hydraulic, or mechanical rod manipulation. Further, it specialises in electric cable-winding drums, spring controlled and also hand wound, fitted with slip ring and brush contacts when required.

(To be continued.)

NOTES FROM CANADA.

(From Our Special Correspondent.)

There has recently been formed in Canada, apparently with headquarters in Toronto, "The Canadian Association of British Manufacturers and their Representatives," the objects of which are "to further the interests of British trade throughout the Dominion of Canada and to affiliate with and work in concert with kindred associations in other centres of the Dominion having similar objects."

The above is quoted from the articles of the constitution, which further state that: The association shall consist of British subjects only:—

"(*a*) British manufacturers and wholesale exporters from the United Kingdom."

"(*b*) Representatives and agents of British manufacturers and wholesale exporters from the United Kingdom."

"No representative or agent of British manufacturers who enters into any agency agreement with, or in any way represents, any manufacturers or wholesale exporters whose principal works or place of business is situated in any country deemed by the Supreme Council to be or to have been hostile or unfriendly, shall be entitled to membership of the association."

"The amount of the annual subscription shall be: (*a*) For British manufacturers and wholesale exporters, $15.00 per annum; (*b*) for representatives and agents of British manufacturers and wholesale exporters, $7.50 per annum."

Under the heading of by-laws appear the following:—

"The expression 'British manufacturers and wholesale exporters' used in clause 6, sub-section A of the constitution, shall be understood to mean British manufacturers and wholesale exporters who are already represented in Canada by a resident agent."

"The trade sections shall consist of the following classifications:—

"(*a*) Cotton and wool fibres."

"(*b*) Food products."

"(*c*) Metal products, comprising iron and steel and all other metals and manufactures thereof."

"(*d*) Clay products, comprising earthenware, stoneware, glassware, and all manufactures of clay and its essentials."

"(*e*) Wood products."

"(*f*) Chemicals, comprising heavy chemicals, dyestuffs, oils, drugs, drug sundries, polishes, and kindred materials and manufactures."

"(*g*) Leather products, comprising hides, leather, findings and all manufactures of leather."

"A new trade section may be formed upon the written application of any six members of that particular trade."

A meeting of the Toronto branch of this association was held recently in Toronto and was attended by about 25 members.

The trade sections already formed (as indicated above) were asked to nominate a chairman and secretary; this was done in the case of several sections, and it was then decided to institute a special drive in order to obtain as many new members as possible. The drive is to begin at once, and last for one month.

At present the Toronto membership is about 50, but it is believed that about 250 can be obtained if all those eligible can be induced to join. This latter number would represent probably 2,000 or more British firms, as many of the members are agents for several different companies.

The association has been formed more for the purpose of increasing the number of British agencies in Canada than increasing the number of agents, and it was stated at the meeting that H.M. Imperial Trade Commissioner at Toronto (Mr. F. W. Field), who has had a good deal to do with the formation of the association, would forward any inquiries which he might receive in future from British firms, as to the openings existing for suitable representation in Canada, to the association for its consideration.

So far as could be judged by the writer, the members of the association present at the meeting were all very enthusiastic about it, and once it has got fairly on its feet there is little doubt that its influence will be felt in Canada, and, be it hoped, at home also.

The general impression gained at this meeting was that all the men there were keen, honourable business men who knew what they wanted, and were determined to use their best efforts to get it. If British firms are ever to make any headway in Canada now is the time to begin trying, and this association should prove a great boon to firms at home in assisting those already represented, and in advising those desirous of obtaining proper representation.

In the Electrical Review of August 1st, on page 146, appeared three photographs showing the condition of some of the tramway track in Toronto.

The editorial remarks very nicely and courteously ascribe the conditions indicated "to the great war," but, sad to say, such a state of affairs has existed for the past ten years or more, not only "on Front Street, between the Union Station and George Street," but at much more important locations, such as the intersection of Yonge Street and Queen Street, Yonge Street and Richmond, Yonge Street and King Street, and innumerable other points—such sights are not by any means "abnormal" any more than is overcrowding on the cars. Regarding this latter subject, it may be said that there are *usually* during rush hours at least as many persons standing up inside the car as are occupying the seats, and that the rear platform and the steps are crowded to the very utmost with young men and boys of a foolhardy turn of mind hanging on to any little support or ledge that offers a precarious foothold. That this condition is not abnormal may be judged from the fact that the people of Toronto have been agitating continuously to have it altered since at least as long ago as 1899—the writer recently saw in the records of the City Council of that year a resolution demanding that something be done immediately to force the Toronto Street Railway Co. to provide a better car service, as the overcrowding was intolerable—or words to that effect. At the same time it was pointed out that similar efforts to induce the company to do something had been repeatedly ignored in the past. Evidently, therefore, the history of this state of affairs goes back to at least the Jubilee year or earlier, and the long-suffering public puts up with these conditions even yet, but perhaps there is more excuse for the company's *dolce far niente* policy now than formerly as the franchise expires in 1921, and is not likely to be renewed. Moreover, the city of Toronto itself owns several car routes now, and it cannot be said that the overcrowding conditions on the city's own cars are any better than those on the company's cars. However, as in other matters, human nature can accustom itself to anything.

THE MUNICIPAL TRAMWAYS ASSOCIATION.

(INCORPORATED.)

(*Concluded from page* 392.)

Annual Report.

The report of the Executive Committee for the year 1918-19 recorded a total membership of 201 (85 local authorities, 116 managers and assistants). Mr. W. Clough (Bury), who was appointed hon. secretary at the last annual general meeting in succession to Mr. C. J. Spencer, left municipal service, and Mr. G. W. Holford (Salford) was appointed in his place. At a special meeting on May 16th the Association authorised the Executive Council to appoint a general secretary, and Mr. J. Beckett, borough treasurer, of Accrington, was selected out of no fewer than 740 applicants. At a special meeting of the Association in May last it was decided to discontinue the meetings of the Municipal Tramways Conference, which had been dealing with wages, &c., and that the Association should in future handle such questions; it was also agreed that the subscriptions payable by local authorities should be raised, to meet the increased expenditure, a scale being adopted ranging from 10 guineas a year where the annual revenue was under £20,000 to 100 guineas where the revenue was over £1,000,000

The British Engineering Standards Association dealing with wheel centres decided to recommend a diameter of 27 in. for driving wheel centres, with a diameter of 32 in. or 33 in. over the tread, and 17 in. for pony wheels, 22 in. over the tread.

The Association concluded an agreement with the National Transport Workers' Federation on March 20th, 1919, which was appended to the report. The draft constitution of the Joint Industrial Council was approved by the representatives of the two Tramway Associations and the Federation, and was also appended; there will be 14 representatives of the M.T.A., eight of the T. and L.R.A., and 22 of the employés. The first meeting of the Council was held on September 5th, 1919.

Attention was drawn to Clause 5 of the Transport Bill, giving the Minister power to require through running on adjoining tramways belonging to different owners.

The provisions of the Finance Acts of 1918 and 1919, introducing for the first time an annual allowance for the depreciation of buildings, were referred to, and the exclusion of car sheds was stated to be, in the opinion of the Executive Council, indefensible.

During the year three awards were issued by the Committee on Production affecting the wages, &c., of tramway employés; these were summarised in an appendix. Attention was drawn to a report of the Select Committee on Local Legislation, emphasising the anomaly of making municipal authorities contribute to the upkeep and reconstruction of roads, while private enterprise was free from this requirement.

The total income of the Association for the year 1918-9 was £387, and the expenditure £371.

Motor Omnibus Services.

By A. R. Fearnley, General Manager, Sheffield Corporation Tramways and Motors.—(*Abstract.*)

On many occasions recently when the question of road passenger transport has been under discussion the opportunity has been taken of suggesting that extensions of electric tramways should not be made, but that any further transport facilities required on the roads should be provided by motor omnibuses. This opinion, of course, comes from those who have had no experience of handling passenger transport work by the electric tramcar.

I propose to look at the question from the point of view of the municipality engaged in passenger transport work, and to show as a result of the experience gained whilst working motor 'bus services as auxiliary to a large tramway system, during the past seven years, how, and to what extent, motor omnibuses can be best made use of.

Under present conditions it is comparatively easy for any municipality to obtain powers from Parliament to work motor omnibuses within its own district, and despite the opposition which is generally met with from railway and motor 'bus companies, County Councils, and Urban District Councils, it can also obtain powers to work omnibuses in the districts adjoining its boundaries.

In 1907 the Sheffield Corporation obtained a clause which reads as follows:—

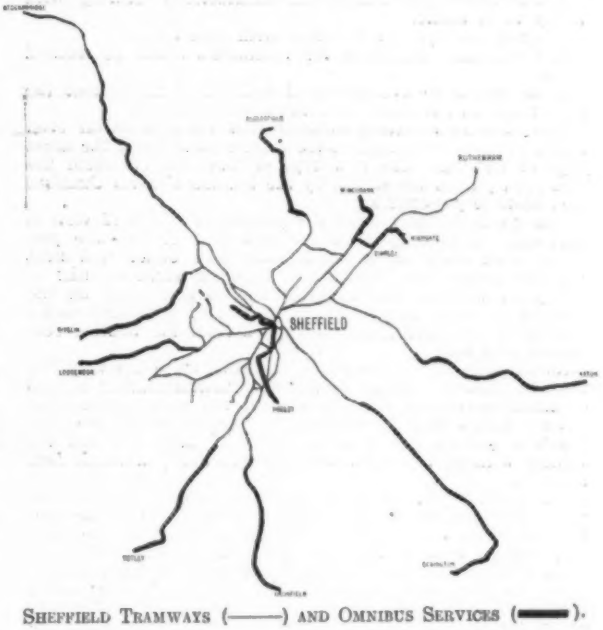
"The Corporation may provide and run motor omnibuses within the city, and also in connection with their tramways in certain districts adjoining the city on the following routes." Then follows a description of the routes outside the city boundary on which the Corporation is authorised to run motor omnibuses, and as will be seen from the map attached most of the main roads leading into the city are now provided with 'bus services; on those which are not so provided powers have been already obtained, and in a short time services will be in operation.

Another clause provides that the Corporation shall make payment to the road authority of ¼d. per 'bus-mile run by its motor omnibuses; also, that the Corporation shall not be required to make any payment in excess of the sum of ¼d. per 'bus-mile in respect of any road which has not been constructed or re-constructed so as to be adapted for mechanical traffic.

Further clauses provide that the Corporation shall not be required to make any payment in respect of the cost of raising the standard of any road to meet the requirements of mechanical traffic, and that if a grant from the Imperial Exchequer is made in respect of any road towards the cost of maintenance the amount to be paid by the Corporation shall be proportionately reduced.

These clauses remain operative for at least five years from March 31st, 1919, and were settled by agreement with the West Riding County Council and the Derbyshire County Council so recently as the summer of 1918, after they had had five years' experience of the running of the motor 'bus services over their roads.

Another clause in which the Sheffield Corporation appears to have been more fortunate than many other undertakings is in the fare clause. Our clause in regard to this matter reads as follows: "The Corporation may demand and take such reasonable fares and charges for the conveyance of passengers and parcels in or on their motor omnibuses as they may think fit."



Sheffield Tramways (———) and Omnibus Services (▬▬).

With the parliamentary authority above referred to, the Sheffield Corporation commenced in 1913 to run motor omnibus services on a number of routes within the city, and as extensions of its tramway routes outside the city, and has continued since that date as opportunity offered to extend such system, until it has now services covering 37 miles of road, of which 15 miles is within the city boundary, and 22 miles outside the city, on County Council roads, and employing altogether about 40 motor omnibuses. At least half-a-dozen additional routes are contemplated, a number of which are to be put into operation as soon as a further supply of suitable omnibuses can be obtained.

The results of the first three years were excellent, but, of course, war conditions, especially during the last two years, made the working of the services very difficult, and at times, owing to the inability to obtain spare parts and carry out repairs, almost impossible.

The expenses for the last two years are as follows:—

Average Expenditure per 'Bus Mile.

	1915. Pence.	1918. Pence.	1919. Pence.
Traffic expenses	3.012	4.931	7.086
General expenses	.370	.380	.532
Repairs account	1.915	4.411	4.528
Road maintenance account	.055	.146	.200
Power expenses (petrol) ...	1.683	4.154	5.550
Total working expenses	7.035	14.022	17.896

Although on country roads the single-deck 'bus is the more satisfactory type of vehicle, the preference in the district for the double-deck 'bus is so pronounced that we have tried as

far as possible to meet this requirement, 75 per cent. being of the latter type.

On city routes this class of service undoubtedly provides a great public convenience for short-distance cross-town traffic through streets and districts which cannot be served by cars.

The traffic which has been developed on roads branching off from tramway routes is enormous, and has astonished its most sanguine advocates.

The use of 'buses as extensions to existing tramway routes has also proved very satisfactory. In addition to paying their way, they have brought a great amount of traffic to the tramways. What this means in the summer months may be gathered from the motor 'bus traffic return for the last completed week, ended August 17th, 1919:—

Receipts, £2,172 7s. 11d. (fare 1½d. per mile).
Passengers carried, 159,371.
Miles run, 20,768. (Lost mileage, 59 miles.)
Receipts per 'bus mile, 25.1d.
Receipts per 'bus mile up to date this year are 23.59d.

The traffic on 'bus routes is greater in the summer months than in the winter months, the ratio of difference being much greater than on the tramways. There is no doubt that the general effect on the outlying districts is in every way of great benefit.

The motor omnibus, so far as it has been developed up to date, is:—

1. An excellent vehicle in acting as feeder of and in connecting up tramway routes and services.
2. An unsuitable vehicle for satisfactorily dealing with heavy town traffic.
3. Quite inadequate for dealing with peak loads.
4. Financially impossible for workmen's traffic at reduced fares.
5. In regard to average speed maintained throughout the day it has no advantage over the electric tramcar.

The maximum seating capacity that we have so far been able to provide is 37 against the maximum of 76 on the latest type of tramcar. The new type of 'bus, one of which has just been put on the streets by the London General Omnibus Co., seats 46 passengers.

The great difficulty from the passengers' point of view is that only 22 passengers on the new type of 'bus are provided with cover or a comfortable seat under inclement weather conditions, which prevail during eight months in the year, whereas the whole of the 76 passengers on the tramcar referred to are under cover and travelling under reasonably comfortable conditions, whatever the weather conditions may be.

As the majority of the members know, there are very few tramcars running to-day in the busy manufacturing centres or thickly-populated districts without top covers, experience having shown that for the greater portion of the year the top-deck seat on the open-top car is of little use, and the vehicle without top cover becomes practically a single-deck tramcar.

For dealing with the peak loads the Sheffield type of 'bus, with its maximum of 37 seats, would be of very little use; for the Tinsley district in Sheffield, each evening we have to provide a service of 82 cars per hour, in which time we carry 5,576 passengers at an average fare of less than ½d. per mile. To carry these passengers the number of 'buses would have to be double the number of cars provided, and in wet or winter weather this would be totally inadequate for the purpose. Given this necessary increase in the number of vehicles, serious loss would result if the same fares as are now charged on the tramways were maintained.

The 3½-ton maximum weight allowed for the London 'bus is of no use for the provinces. Actual experience has shown us that a body of the London type after two years on roads such as are met with in the Midlands and North Country is in such a condition that very heavy repairs are required, and, in fact, it then becomes a question whether such type of body is worth repairing for work under such conditions. The makers themselves have confirmed this opinion, and to-day decline to build a body of that type for use in the provinces.

The minimum weight of a double-deck omnibus for roads such as are found in our district is 4½ tons, and the difference in weight of vehicle per passenger carried in the provinces is, therefore, very little in favour of the motor omnibus, as compared with the tramcar.

Appended are some figures for the year ended March 25th, 1919, showing:—

1. The revenue expense of running the motor 'bus is 44.5 per cent. more than the tramcar. After giving the motor omnibus the benefit of its comparatively lower capital expenditure it still costs 33.7 per cent. more than the tramcar to work per mile.

2. The revenue expenses per passenger carried on the motor omnibus are 198 per cent. more than on the tramcar. The total expenses per passenger carried are 176 per cent. more on the 'bus than on the tramcar.

3. Per seat provided the omnibus revenue expenses are 131.3 per cent. higher than the tramcar revenue expenses. The total expenses per seat provided are 114.1 per cent. higher on the 'bus than on the tramcar.

The average speed of the 'buses is 9.97 miles per hour; of the tramcars 8.65 miles per hour, that is: 15.26 per cent. in favour of the 'bus. Bearing in mind, however, that 75 per cent. of such 'bus mileage as is here referred to is run on urban and rural roads, it will be seen that under similar conditions the speed of the tramcar in the provinces is easily equal to the speed of the 'bus, so that in this respect there is nothing to choose between the two vehicles.

What is very necessary at the present time to assist the motor omnibus undertakings in carrying out their work is a plentiful supply of fuel, at a reasonable price; that is not a price ½d. or 1d. below the monopoly price of the petrol ring, which is not the way to encourage the use of either benzol or any other home-produced motor fuel.

In conclusion, I would like to suggest that it is the duty of every tramway-owning municipality to undertake this work.

Comparative Figures from the 1918-19 Sheffield Accounts.

1	Per car mile. d.	Per 'bus mile. d.	'Bus expenses are—
Working expenses	12·388	17·896	44·5% more than tramways
Service of debt (capital)	1·688	·923	45·3% less than tramways
Total expenses ...	14·076	18·819	33·7% more than tramways
2	**Tramways, per passenger. d.**	**Omnibuses, per passenger. d.**	**'Bus expenses are—**
Working expenses	·716	2·137	198% more than tramways
Service of debt (capital)	·098	·110	12·3% more than tramways
Total expenses ...	·814	2·247	176% more than tramways
3	**Tramways per seat per car mile. d.**	**Omnibuses per seat per 'bus mile. d.**	**'Bus expenses are—**
Working expenses	·230	·532	131·3% more than tramways
Service of debt (capital) ...	·031	·027	12·9% less than tramways*
Total expenses ...	·261	·559	114·1% more than tramways
4	**Per car mile. d.**	**Per 'bus mile. d.**	**'Bus receipts are—**
Traffic receipts ...	16·563	20·457	23·5% more than tramways
Traffic receipts per seat provided	·307	·608	98% more than tramways
			'Bus fare per mile is—
Average fare charged per mile..	·652	1·5	130% more than tramways

*This is an important figure and one which is often entirely overlooked by the motor 'bus advocates—the impression usually left is that the difference in capital expenditure is much greater.

Discussion.

In opening the discussion Alderman E. Russell Taylor (Liverpool) said he had come to the conclusion that the motor omnibus was a very keen rival to the tramcar because of the ever-increasing cost for permanent way and the extraordinary costs that would have to be incurred in the future for the overhead equipment of a tramway system. The great development of the internal-combustion engine increased its possibilities as a method for traction to such an extent as to render it a formidable competitor to the tramway system. The vast capital sum involved and the large annual charges enormously handicapped a tramway system as compared with a motor-'bus system. By an absurd clause in an Act of Parliament the weight of the motor 'bus was restricted to a limit which rendered it impossible to obtain the seating capacity which was sufficient to give the omnibus the same earning power as the tramcar. But with the advent of the new Ministry of Transport, it was to be hoped that this anomaly would be wiped out and that the motor omnibus would have a fair chance as a competitor to the tramcar. The motor omnibus, owing to its great mobility, was capable of running a larger number of journeys than the tramcar within a given time, and its course could be diverted in order to avoid obstructions. Local authorities should seriously consider the possibilities of the motor omnibus as well as the tramcar, as both could at the present moment be usefully employed in dealing with the congestion of the passenger traffic in all their large centres. With the co-operation of the municipal authorities there should not be any difficulty in removing all restrictions and disabilities connected at present with the motor-'bus, and he believed that at no distant date municipalities would have more 'buses than tramcars.

Mr. Webber (Keighley) said that in Keighley they had had motor-'buses for five years, and their experience was that the motor-'bus was most unsatisfactory. They took up in its place the railless trolley, which they found was undoubtedly better than the 'bus. The cost of petrol as given by Mr. Fearnley was 5d. per mile. In Keighley they could run a railless vehicle with very nearly equal carrying capacity for about 1½d. per mile. He was against using any other power, when electricity generated by his own Corporation was there to be utilised.

Mr. C. B. Hamilton (Leeds) said that for big industrial centres there was no comparison between the motor-'bus and the tramcar. The cost per seat provided—and after all that was the criterion—was double that of the tramcar. Mr.

Russell-Taylor had omitted to say anything about the roads in his statement of capital expenditure. So far as municipalities were concerned the roads for motor-'buses must be provided and maintained by them. Taking everything into consideration, he maintained that in the actual cost of operating the two vehicles the cost of the motor-'bus was double that of the tramcar. Those who talked about the great possibilities of the motor-'bus seemed to forget that there were also great developments to be made yet with regard to tramways. He believed that in the tramways they had the best method of moving large bodies of people.

Mr. J. Dalrymple (Glasgow) asked Mr. Fearnley to explain what was the exact point or time when he would discard the motor-'bus and introduce a tramway car. Mr. Fearnley replied that that all depended on local circumstances. No hard and fast line could be drawn.

Mr. W. Murray (Walthamstow) said that apart from any controversy as to the merits of the two vehicles, there was an opening for the motor-'bus over city routes as an auxiliary service to the tramways. In the rush hours especially it would be of convenience to the public if the tramcars carried the short-distance passengers and the motor-'buses the long-distance passengers, who would have the additional advantage of being carried at a quicker rate.

Mr. Monkson (Stockport) said that in Stockport they were about to institute a motor-'bus service over one of the routes where they had had a railless trolley—which they had abandoned. They had never found the railless trolley satisfactory.

Sir John W. Courtis (Cardiff) said that in Cardiff they were considering the advisability of adopting a motor-'bus system either to run on the streets where they had already tramway routes or to act as feeders to the various termini. Regarding the suggestion that the weight of the motor-'buses should be increased, he said that even at their present weight he could always tell when a motor-'bus had been on a road from the damage it caused, and if the weight were increased, the roads would require to be of very different construction altogether.

Mr. A. Baker (Birmingham) said they had a very large fleet of omnibuses in Birmingham, and the loss of mileage was becoming a diminishing quantity. That showed that the motor omnibus was becoming more stable. Regarding the question asked by Mr. Dalrymple, he could say that when they got a population sufficient to satisfy a quarter-of-an-hour omnibus service, that was the time to lay down a tramway line.

Mr. Wilkinson (Bradford) contended that the railless trolley was only at the fringe of its career, and could be improved to such an extent as to make it a serious rival to the tramways. Roughly speaking, its working expenses to-day were 25 per cent. less than those of the tramcar.

Mr. J. M. McElroy (Manchester) was of the opinion that to carry a great body of traffic, the tramcar held the field at the present moment.

Councillor J. W. Squires (chairman, L.C.C. Highways Committee) said that all depended on the district where they were going to run the 'buses. In London the General Omnibus Co. could go where it liked. During the war the company, by some means or other, carried munition workers to Woolwich Arsenal and received a subsidy in one year of £130,000. The London County Council had made up its mind to seek powers for running motor-'buses. He did not want to start motor-'buses in sheer competition with the London General Omnibus Co., but he wanted motor-'buses to subsidise their own tramway service.

After further discussion, Mr. Fearnley received a warm vote of thanks for his paper.

ELECTRIC FURNACES.

The interesting programme which was arranged in connection with the visit of the Institute of Metals to Sheffield contained little of a directly electrical nature, but included one item of particular interest to the central-station engineer and the electrical manufacturer. This consisted of a series of kinematograph exhibitions, given by Mr. Verdon O. Cutts, of Sheffield, which showed electric furnaces in operation, melting non-ferrous metals and alloys, and annealing and heat-treating steel and non-ferrous products. These are the furnaces developed by Baily in the United States, which are being introduced on this side by Mr. Cutts's firm; they are of the resistance type, and it would appear from Mr. Cutts's description that they open up a very important field for the central-station engineer. It is claimed that their highly non-inductive load, with a power factor of 98 per cent., and a load factor of 90 to 100 per cent., has been fully demonstrated by experience with a large number of such furnaces which are in regular commercial operation in the United States. Such an electric furnace load is in sharp contrast with the steel furnace of the arc type, with which we are more generally acquainted in this country.

The melting furnaces are of three distinct types, viz., the pit, tilting, and tapping types; they range in size from 40 kw. up to 1,000 kw. A typical round-pattern tilting furnace, which figured largely in Mr. Cutts's pictures, is provided with specially wound transformers of 105 kw. capacity; it consists essentially of a steel shell 7 ft. in diameter, mounted on trunnions and brackets for tilting. The shell is suitably lined with refractories, the hearth being located at the bottom of the furnace and bowl shaped. The domed roof is suitably encased, and is capable of being raised and lowered by one hand wheel. Kisselguhr is used between the casing and the lining as a heat insulator, and the roof framework is provided with a circular fin which dips into a sand seal. Over the furnace hearth is situated an annular trough of carborundum fires, and which contains the resister material. Fixed electrodes enter this trough at two points diametrically opposite; these serve to make the permanent electrical connection to the resister bed. A charging and working door of the plug type is provided, and this constitutes the only opening to the furnace, the pouring spout being located immediately below. The furnace can be poured without opeping the door. A ribbed cast-iron plate, hung from a counterweighted lever, enables the doorway of the furnace to be partially closed when the swing plug door is opened for the purpose of working the hearth. This shields the operator from the intense heat of the furnace, and decreases the loss of heat.

The necessary heat is generated by the resistance of the carbonaceous material in the trough to the passage of the electric current. Special transformers having their primary side suitably wound for the electric supply available form an integral part of the installation. They are provided on the secondary side with a number of different voltage taps. This arrangement in conjunction with a selective oil-break switch of special design gives a fine degree of control.

The heat generated in the resister trough is transmitted to the hearth by direct radiation, and indirectly from the arched roof. The direct radiation from the lower part of the trough is obtained by mounting the trough on piers, this leaving a considerable area of the trough bottom exposed to the hearth. It is interesting to note that this heating element has a radiating surface of over 40 ft.

It will be obvious that a furnace so designed must necessarily be rather large compared with its output. That described above has a normal hearth capacity of 15 cwt., and a melting rate of approximately 6 cwt. per hour. In proof of its flexibility as a unit, Mr. Cutts is able to cite instances of its commercial use with charges ranging from 5 cwt. to over 30 cwt., and under favourable conditions the melting rate is considerably increased. It is further evident that a furnace of this type must be somewhat sluggish in operation, and it is conceivable that this may be regarded as a disadvantage. It is, however, this feature which renders the furnace susceptible to very precise temperature control, which is a most desirable quality for non-ferrous work.

The reduction of metal losses in melting is of considerable importance. Melting records of numerous furnaces in regular commercial operation, melting yellow brass scrap, show a total loss of less than 1 per cent. These records are taken over considerable periods and under normal shop conditions. This not only makes for the conservation of metal and the elimination of waste, but also minimises the danger of occupational disease due to the emission of zinc fumes from the furnace. It will therefore be evident that the furnace is particularly suitable for melting bronze, brass, aluminium, zinc, anti-friction alloys, &c., and especially those metals which readily oxidise and volatilise.

The electrodes, being embedded in the furnace walls and resister bed, are fixtures and inaccessible to the atmosphere. Consequently, there is practically no erosion or electrode consumption. Incidentally, they require no adjustment, which makes for simplicity of operation. The energy consumption with this size of furnace varies between 300 and 350 kw.-hours per ton of yellow brass scrap melted.

The tapping type of furnace is rectangular in shape, and is fitted with two or more straight resister elements. The larger sizes have motor-operated doors with an electrically-operated charging device. Two typical examples may be mentioned. There is a furnace of 500 kw. capacity which has a hearth capacity of 3 tons of aluminium. This same furnace has a capacity of 9 tons of brass and a melting rate of 2 tons per hour, when supplied with 600-kw. transformers. A 1,000-kw. furnace has a capacity of 200 tons of zinc per day, with an average energy consumption of 74 kw.-hours per ton. In this instance the metal dross amounts to 2.43 per cent.

The melting furnaces described were developed as the result of experience with furnaces installed for heating without melting for such operations as annealing, heat-treatment, &c. These heating furnaces are exactly similar in type to those used for brass melting. They are usually rectangular in shape, with an arched roof, and straight resister elements running along each side of the interior of the furnace over the hearth. The precision with which the furnace temperature and atmosphere is controlled enables a steel or other product to be subjected to the exact heat treatment specified by the laboratory. Where there is an appreciable amount of repetition work, or work of approximately the same bulk for similar treatment, automatic furnaces are employed. In such cases the only manual labour required is to place the castings, forgings, or other pieces, on the charging platform of the furnace. All subsequent operations, including the actual charging, heating, quenching, and passage through the drawing furnace, are controlled by means of pyrometers or a time-element device. Thus the human element is completely eliminated, and the furnaces are rendered practically fool-proof. The installation thus partakes more of the nature of a heat-treating machine, than of that of a furnace only,

and a machine-like precision is rendered possible. One such installation used for heat-treating forgings consists of a hardening furnace provided with 600 kw. and a drawing furnace of 300 kw. capacity, with a quenching tank situated between the discharge end of the first furnace and the charging end of the second furnace. The cycle of operations may be described briefly as follows: When the pieces nearest to the discharge end of the hardening furnace have reached a pre-determined temperature, thermo-couples operate automatic gear through relays, and the doors of the first furnace are opened. The electrically operated pusher places the cold pieces for treatment in this furnace, thereby ejecting those at the discharge end which have attained to the desired temperature. These are received by a hydraulically operated manipulator which places them in the quenching medium, at the same time closing the motor-operated doors. The time taken in quenching is governed by a time relay. The manipulator then withdraws the material from the quenching tank and places it in front of the charging door of the drawing furnace. In doing so, the doors of this furnace are opened, and immediately the material is pushed into the furnace, the completely heat-treated pieces being ejected at the discharge end and the doors closed.

Other automatic furnaces have been constructed for the heat treatment of steel balls for bearings, small finish-machined aeroplane parts, cast-steel anchor chains, draw-bar knuckles, and a variety of other work.

For work requiring very gradual heating and cooling, and where large output is essential, the installation is of the car type, with pre-heating chambers and a hood for slow cooling. One such installation which is used for the annealing of sheets, steel strip, &c., is over 200 ft. long. Two lines of cars are provided, travelling in opposite directions. The cold material, as it enters, is pre-heated by the hot material approaching the discharge end of the track. This makes for economy of operation to a very marked degree. It has a capacity of 150 tons per day, and operates at temperatures up to 1,400 deg. F.

One interesting fact is that the ability to give the precise heat-treatment which these furnaces render possible, has enabled one firm to use plain carbon steel where it was previously found necessary to use special alloy steels.

A COTTRELL PRECIPITATOR IN A CEMENT PLANT.

The Clinchfield Portland Cement Corporation has just completed the installation of a complete Cottrell precipitating plant, comprising both a dry treater and a wet treater, for precipitating the dust from the cement kilns, with the two-fold object of recovering potash and eliminating a nuisance. A steel flue 9 ft. wide by 14 ft. deep, provided with hopper bottoms and a screw conveyor beneath, conveys the gases from the kiln to the dry treater. This flue, and also the stacks which permit the gases to escape into the atmosphere, are provided with dampers, so that the gases may either be allowed to escape or be diverted to the treater at will. A small quantity of dust low in potash may be precipitated in the flue. The flue is 102 ft. long, and on the top of it, to utilise some of the waste heat, there are evaporating pans for evaporating the solution returned from the wet treater. By means of the screw conveyor underneath the flue, the dust can be returned to the kiln, in case the price of potash should not warrant putting the dust on the market. The portion of the flue nearest the dry treater is provided with a water spray inside, to humidify the gas.

The dry treater, built of steel and brick, consists of four chambers, two on either side of a central combination inlet and outlet flue. This flue in its entirety is rectangular in shape, with a diagonal steel partition extending from the bottom of the inlet end to the top of the outlet end. The top part, above the partition, is the inlet flue, and the bottom part, below the partition, is the outlet flue. The ports for letting the gas into and out of the four treating chambers are provided with dampers. In each chamber the gases pass down through eighty 12-in. iron pipes, each 15 ft. long. In the centre of each pipe, from top to bottom, hangs a soft annealed iron wire, No. 14, B. & S. gauge, with an iron weight, shaped like the frustum of a cone, weighing about 9 lb., suspended at the bottom. To keep the wires from swinging, and to keep them spaced properly, the wires pass through an iron grid, placed 15 in. below the bottom of the 12-in. pipes and just above the 9-lb. weights.

The current is transmitted by means of a ¾-in. iron pipe connected to a bus bar made of 5-in. iron pipe. This is connected to the various iron wires suspended in the 12-in. pipes. The bus bars are insulated by means of Alberene stone slabs. The insulators consist of eleven slabs, six of which are 6 in. by 6 in. by 1 in. thick, and five 9 in. by 9 in. by 1 in. thick.

The four treaters discharge the gases into a common outlet flue, which leads to a Buffalo Forge Co. conoidal multiblade fan, with an impeller 12 ft. in diameter and a speed of 144 r.p.m., and said to be capable of discharging 180,000 cu. ft. of gas per minute.

The dry treater will precipitate only the coarser dust. The very fine dust and the fume will be blown by the fan to the wet treater. The temperature of the gas in the dry treater ranges from 900 to 1,100 deg. F. The capacity is 20 tons of dust per day, which is expected to contain about 10 per cent. of water-soluble potash (K_2O).

The wet treater, like the dry treater, has four chambers, but here the chambers are arranged in a single row, with the inlet flue passing along one end of the four chambers. The gas is blown into this flue by the large fan mentioned above, and is admitted to the treater chamber through the dampers of the "jug" type, two dampers being provided for each chamber. The gas passes upwards through the damper openings (about 36 in. in diameter) then turns at right angles to the left and passes into the chamber, which is provided with six vertical concrete partition walls, each 6 in. thick by 10 ft. wide by 14 ft. high, built 15 in. apart. These walls divide the chamber into seven compartments, and in each compartment there are suspended, between the walls, 24 iron wires, No. 14 gauge, weighted at the bottom with 30-lb. weights, and connected to one another at the bottom by a grid made of 1¼-in. iron pipe. There are 168 of these wires in all in each chamber. The surfaces of all the walls are covered with flowing water, which is distributed at the top by means of a system of pipes. The gases, after turning to the left, pass through the seven compartments, the fine dust and fume are precipitated by the high

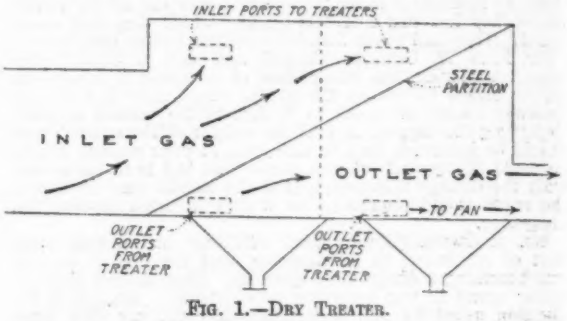


Fig. 1.—Dry Treater.

tension current with which the 168 wires are charged against the wet walls, and are washed by the flowing water to the bottom, and the gas passes on to the left end of the compartments, and escapes through a damper hole to an outlet flue which connects with all four of the chambers, and leads to a concrete exit stack, 8 ft. in diameter by 18 ft. high.

Power for the treaters is obtained from the Kingsport Utilities Corporation at 440 volts, and by means of four motor-generators it is changed to 220 volts, a.c. single-phase, and is then stepped up by transformer to 75,000 volts.

The precipitated liquid and dust are collected in a tunnel beneath the treater chambers, and flow to a concrete settling tank 24 ft. in diameter by 12 ft. deep at the deepest part, the bottom being funnel-shaped. The liquid is pumped to the evaporating pans on top of the gas flue, and is there evaporated. The sludge from the settling tank is filter-pressed, and the cake rejected. The filtrate returns to the settling tank, and is pumped along with the other liquid to the evaporating pans on the flue. The evaporation is not carried to dryness, but at a definite specific gravity the liquid is drawn off into two final evaporating pans 16 ft. long by 8 ft. wide by 3 in. deep, fired with coal, where the evaporation is completed and solid crude potash is obtained. The Cottrell plant, as well as the cement mill, was designed and built by Richard K. Meade & Co., Baltimore, Md.—*Chem. & Met. Engineer.*

EFFECT OF RAILWAY ELECTRIFICATION ON TELEGRAPH AND TELEPHONE LINES.

In a recent contribution to the *Annales des Postes Télégraphes et Téléphones*, Prof. A. Mauduit stated, in recommending the electrification of French railways, that it would be necessary to remove telegraph and telephone lines to a distance from the electrified track, or, according to circumstances, to use bifilar, lead-sheathed, overhead or underground cables. This is the solution adopted in Switzerland and Italy, but it is not always practicable to remove the lines far from the railway, and, as pointed out by M. G. Valensi in a later contribution to the *Annales*, experience in the United States indicates that the conversion of lines to bifilar cables and their mechanical displacement from the electrified track are not sufficient to prevent interference. On the contrary, it is essential to take all steps possible to restrict the magnetic field of the traction system, *e.g.*, by the use of counter-current wire, double-bridge distribution with compensating auto-transformers, and so on. Even these precautions, whilst securing satisfactory results under normal conditions in the traction system, can hardly prevent troublesome manifestations of electromagnetic induction in telegraph and telephone stations and in the homes of telephone subscribers under abnormal conditions, and, in particular, when short circuits occur on the traction system.

From an analytical investigation of the electrostatic and electromagnetic fields within a lead-sheathed, bifilar telephone cable, due to an adjoining traction line, the author concludes that the earthed metallic sheath of the telephone cable protects the telephone circuit from electrostatic induction but has no appreciable effect as regards electromagnetic induction. The magnetic field induces in the circuit: (i) a transverse voltage, *i.e.*, a potential difference between the two wires, tending to circulate a current through the wires in series. The two wires being stranded together on a helix of small pitch, this effect is generally very small, notwithstanding the strength of the inducing field. (ii) A longitudinal voltage, *i.e.*, a potential difference between the two wires (taken in parallel), and the earthed sheath of the cable, the circuit being completed by the distributed capacity between the telephone wires and the lead sheath. The area of such a circuit may be very considerable, and is, for instance, 10 sq. m. per kilometre of parallelism between traction and telephone lines, if the conductors of the latter be 1 cm. from the inside of the lead sheath. The variable magnetic field linked with such a circuit may naturally induce an important difference of potential between the telephone conductors and the lead sheath. By symmetry, the middle point of the telephone lines (supposed influenced throughout their length) should assume earth potential, maximum p.d. between these wires and earth occurring at the ends of the circuit, *i.e.*, at the exchange switchboard or subscriber's installation. Although the sheathing is a perfect screen as regards electrostatic induction, and although the conductors be stranded in pairs, electromagnetic induction is capable of developing dangerous voltages in either overhead or underground cables.

The preceding remarks apply not only to single-phase traction systems, but also to three-phase systems,* and, to some extent, to D.C. systems, the magnetic field produced by the latter being far from constant owing to normal service variations in traction load, and owing to components varying periodically due to generator and motor teeth, collector operation, and so forth. In all cases, the current in traction contact-conductors is relatively heavy, and its return is to a great extent through the earth, so that the area of the inducing loop is large. Also, traction systems are inherently more subject than other circuits to abnormal load variations and short circuits.

The effects of electromagnetic induction in telegraph and telephone systems from traction systems may be considered under the three main headings: Operating troubles; damage to material; and injury to persons. Operating troubles include total interruption of telegraphic or telephonic service by destroying fuses, damaging insulation, and so on; false calls; noises on telephone systems; and disturbance of balance or falsification of signals in telegraph circuits. Possible damage to material includes risk of fire, and magnetisation of Pupin coils, resulting in reduced core permeability and reduced effective resistance and inductance. Finally, accidents to persons may be electrical or acoustical shocks—certainly unpleasant, and possibly dangerous.

The author gives particulars of a number of American traction systems, and of the experience obtained therefrom concerning interference with telegraph and telephone operation. It is found that, in spite of all precautions on single-phase traction systems, short circuits on the latter cause disturbances in lead-sheathed bifilar telephone cables situated even as far as 500 m. from the track. In particular, there are caused danger of fire, risk of electric or acoustical shock to telephone subscribers, and frequent false calls. The quality of the telephone service is thus materially deteriorated.

Owing to electromagnetic induction it is difficult to operate satisfactorily a telegraph or telephone system which, in places, is near a single-phase or three-phase traction system, even though the weak-current circuit be bifilar and lead sheathed. The effect of magnetic induction from D.C. traction systems is less serious, but, on the other hand, there is danger of electrolytic damage. Close and continuous co-operation between telegraph (or telephone) engineers and the engineers of the traction system in all details of technique and operation is considered to be the only way of preventing interference between the traction and weak-current systems. No measures taken in the latter alone appear to be entirely effective.

Twenty-four-Hour Time System.—The Home Secretary has appointed a Committee to consider and report as to the advisability of adopting in the United Kingdom, for official and other public purposes, the 24-hour clock. The idea appears to be to synchronise our timing system with that prevailing in most Continental countries. In France the 24-hour method seems to have had little or no effect upon the popularity of the 12-hour dial. In the 24-hour system time is expressed in four figures, zero being inserted where necessary. Thus, 9 a.m. is 0900 and 11 p.m. 2300; there is no midnight, the time being either 23.59 or 00.01. This system was adopted by the British Army in 1917, and by the South-Eastern and Brighton Railways for their Continental timetables in July last.

*The disturbing current being the "residual" current of the three-phase system; see *Annales des P.T.T.*, pp. 526-607, 1918.

BUSINESS NOTES.

The French Thomson-Houston Co.—At the recent general meeting of the Compagnie Française Thomson-Houston, the chairman foreshadowed that the company would shortly have to raise new resources, which were rendered necessary by the development of business, the realisation of a great industrial programme, and the expansion of trade in various foreign countries. As a consequence, the directors have now decided to submit for the approval of the shareholders a scheme for increasing the share capital by £3,200,000 by the issue of 160,000 new shares of nominally 500 fr., so that the total share capital will be advanced to £8,000,000. The new shares, which will be payable in cash by the end of this year or the beginning of next, will participate in the profits for 1919, and for this purpose the premium of 100 fr. (600 fr. per 500 fr. share fixed on the last occasion when new capital was offered) will be increased to 130 fr., so that the price of issue will be 630 fr. per share. A total of 140,000 shares for nominally £2,800,000 will be offered to existing shareholders, whilst the balance of £400,000 will be subscribed in cash by the General Electric Co. of New York in order to afford the latter a direct interest in the French company's undertaking.

Plant for Sale.—The Ministry of Shipping, St. James's Park, S.W., has for disposal a large quantity of new ship building machinery, including planing, drilling, and shearing machines, &c. Full particulars are given in our advertisement pages to-day.

Import Restrictions Department.—The *Times* stated, on September 27th, that the Import Restrictions Department of the Board of Trade would cease to exist "within a few days."

The British Industries Fair.—In connection with the British Industries Fair, the Board of Trade are sending out over 100,000 invitations to buyers at home and abroad. It is "up to" manufacturers and traders, therefore, to see that the exhibits in every trade affected are fully represented. Those responsible for the Birmingham Section of the Fair are making special efforts to avoid any weakness in this direction, but we understand that one of their greatest handicaps is the apparent inability among potential exhibitors to realise the actual position. In Birmingham the Chamber of Commerce and the municipality are jointly responsible for the organisation of this section of the Fair. It is urged that if the Fair is to be as representative as it ought to be in view of the expected large influx of visitors, no time should be lost by our manufacturers in deciding to take space and in selecting one or other of three sections—London, Birmingham, or Glasgow—for the proper grouping of their goods.

Developments in Poland.—It is reported that the Power and Light Co. which was formed at Warsaw last January for the establishment of electricity works, has increased its share capital from 5,000,000 to 10,000,000 marks, and has taken over the concessions in German hands for works at Pruszkow, and the shares in the Sosnowice central station. The company also intends in agreement with the local authorities to erect generating stations in various localities, and to construct a network of electric tramways to connect together districts which are now not easily accessible.

British Trade-Mark Applications.—Appended is a summary of the recent applications for British trade-marks in respect of goods connected with the electrical trades and industries:—

Asbestogel, No. 391,443, Class 50.—Insulating material composed of asbestos, or other material. Turner Bros.' Asbestos Co., Ltd., Clod Hills, Rochdale, May 21st, 1919.

Autopax Domestic Electric Irons (combined with other lettering and design), No. 391,831, Class 13.—Domestic electric irons made in Great Britain. Automatic Telephone Manufacturing Co., Ltd., Milton Road, Edge Lane, Liverpool, May 30th, 1919.

Clayrite, No. 391,804, Class 6.—Engines, gearing, electric motors and dynamos. Clayton-Wright, Ltd., 114-116, Great Hampton Street, Birmingham, May 30th, 1919.

Tok (lettering comprised with design).—Electric switches, fusible cut-outs, and electrical fittings. Tok Manufacturing Co., Ltd., Empire Works, West Ham Lane, London, E 15, May 27th, 1919.

Arora, No. 392,864, Class 18.—Electric heating and cooking appliances.—Frederick S. Grogan, 143, Ashby Road, Loughborough, June 30th, 1919.

Per Mare Per Terram (lettering combined with name of company and design), No. 392,868, Class 18.—Engineering contrivances for use in wireless telegraphy and telephony. Radio Communication Co., Ltd., 34-35, Norfolk Street, London, W.C., June 30th, 1919.

Diamond-F. (lettering combined with design), No. 390,077, Class 50.—Electrical insulation and other fittings; vulcanised fibre in slabs, rods, tubes, &c. Diamond State Fibre Co., Elsmere, Del., U.S.A., April 10th, 1919.

Metrodes (lettering and design), No. 39,717, Class 13.—Electrodes, being metal goods not included in other classes. Metrodes, Ltd., 87, Fargate, Sheffield, April 29th, 1919.

A Dutch Development.—The Alg. Ned. Electriciteits Mij. (late Groenveld, Ruempol & Co.), of Amsterdam, which is engaged on electrical manufacturing and contracting for installations and central stations, and is now erecting new works for the production of plant, is making a fresh issue of share capital of £41,000, after having made several increases in the past few years. The present emission will raise the capital to £125,000, and powers are being sought further to extend it to £250,000.

A Swedish Expansion.—The directors of the Elektriska A.B. Chr. Bergh & Co., of Malmö, makers of installation materials, have issued their report for the year ended with May 31st, 1919. During the year a considerable extension of the company's activity took place by the absorption of four undertakings in the installation and fittings branches, namely, Sven and Hugo Malmstrom's metal goods factory at Malmö, Svalov's machine shops at Svalöv, Karlstad's electrical installation bureau at Karlstad, and the firm of Lalander & Friberg, of Stockholm. These incorporations rendered necessary an increase in the company's share capital from £126,000 to £315,000 by the issue of new shares at the price of 110 per cent. The net profits advanced from £25,000 in 1917-18 to £34,500 last year, and the dividend is at the rate of 15 per cent., as compared with 20 per cent. in 1917-18, although the amount distributed is greater having regard to the additional capital participating for 1918-19.

Trade Outlooks in Kurdistan and Mesopotamia.—A communication made to the Société des Ingénieurs Civils on the trade outlets in Northern Mesopotamia and Kurdistan states that this region calls for the machinery equipment needful to develop its husbandry and mining resources. It is specially suited to the use of motor culture on a large scale, and there is also an opening for motor traction. In Kurdistan many signs of petroleum-bearing beds are met with, also liquid and solid bitumen, sulphur, pyrites, iron, copper, antimony, &c. The utilisation of this mineral wealth would be greatly helped by the development of the water power of the country, estimated at 500,000 H.P. Railways are likewise a pressing need.

Catalogues and Lists.—The Hoyt Metal Co. of Great Britain, Ltd., Deodar Road, Putney, S.W. 15.—Sixteen-page list giving information regarding their Hoyt anti-friction metals, together with a number of testimonials from users.

Messrs. Falk, Stadelmann & Co., Ltd., 83-87, Farringdon Road, London, E.C. 1.—Forty-eight-page catalogue (No. 436) of electrical accessories. The publication fully illustrates and prices these manufactures, which include lamp-holders, ceiling roses, tumbler and other switches, wall and floor sockets, distributing boards, wood blocks, wires and cables, and many details. Firms in the trade who have not received copies are invited to apply for one.

Messrs. F. J. Shenton & Co., Ltd., 68, Shoe Lane, E.C. 4.—Stock list of English accessories.

The Sun Electrical Co., Ltd., 57, Neal Street, London, W.C. 2.—New catalogue of electric fans, desk and wall fans, in a variety of types, ceiling fans of various patterns, automatic shutters and regulators, ventilating fans, and small-power motors.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester.—Pamphlet on "Large Outdoor Switches and Transformers," by S. Q. Hayes and W. A. Coates, reprinted from the *British Westinghouse Gazette*.

Book Notices.—"Regulations for the Electrical Equipment of Ships." Formulated by the Ship Electrical Equipment Committee of the Institution of Electrical Engineers. London: E. & F. N. Spon, Ltd., or the offices of the I.E.E. Price: American cloth, 2s. 6d. net (2s. 8d. post free); blue cloth, 3s. 6d. net (3s. 8d. post free); paper covers, 2s. 6d. (punched, if desired, for insertion in Messrs Walker's loose-leaf pocket book No. 64.)

"Fuel Economy." Second edition, revised. By W. H. Booth. Pp. 92; 30 figs. London: S. Rentell & Co., Ltd. Price 2s. 6d. net.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVIII. No. 9. New York: The Institute. Price $1.

"Principles of Transformer Design." By A. Still. Pp. vii + 216; 67 figs. London: Chapman & Hall. Price 10s. 6d. net.

"Hydro-Electric Power Stations." By D. B. Rushmore and E. A. Lof. Pp. x + 821; figs. 408. London: Chapman & Hall. Price 28s. net.

"Engineering Directory." No. 66. September, 1919. London: "Engineering," Ltd.

"Essentials of Alternating Currents." By W. H. Timbie and H. H. Higbie. Pp. viii + 374; figs. 223. London: Chapman and Hall. Price 8s. 6d. net.

Our Commercial Secretaries Abroad.—Mr. W. F. U. Scott, H.M. Commercial Secretary for Chile, has left to take up duties at his post, and communications should now be addressed to him at H.B.M. Legation, Santiago.

Mr. E. C. D. Rawlins, H.M. Commercial Secretary for Greece, has also left to take up his duties at his post, and communications should be addressed to him at H.B.M. Legation, Athens.

Mr. E. Hambloch, H.M. Commercial Secretary for Brazil, who has been on a visit to this country, has now returned to Rio, and communications should be addressed to him at H.B.M. Legation, Rio de Janiero.—*Board of Trade Journal*.

Dissolutions of Partnership.—Carr, Geesin & Co.—With reference to this dissolution announced in our last issue, we are asked to state that Mr. Geesin has now merged the business with Messrs. Jonathan Longbotham & Sons, Ltd., of Sheffield, London, and Birmingham, and it is now being carried on at 64, Victoria Street, London, S.W. 1. Telephone: "Victoria 1043."

Leigh Motor Works, motor and electrical engineers, London Road, Leigh-on-Sea, Essex.—Mr. B. C. Tozer and H. J. Harris have dissolved partnership. Mr. H. J. Harris will continue the business under the same style.

Tricker Electrical Installation Co., 2, Asplen Place, Hammersmith, W. 6.—Messrs. R. Tricker, B. Wortman, and C. F. Killella, have dissolved partnership.

West London Dynelectric Co., electrical engineers, 110, Glenthorne Road, Hammersmith, W.C.—Mr. F. G. Baxter and B. Wortman have dissolved partnership.

The Strike Fever Abroad.—According to the *Times* there is considerable industrial unrest in Japan, and workers everywhere are demanding substantially higher wages to meet the increased cost of living. In Kobe Dockyard the workers are forcibly expressing their feelings by the wanton destruction of property.

The strike of metal workers, which has been going on for a long time throughout Italy, was definitely settled on Friday last by the Prime Minister.

The number of metal workers on strike in Germany has now risen to 90,000. At Hamburg the strike of seamen is declining.

The employés of the technical service in the factories at Rombach, Lorraine, threaten to close the factories if several Belgian and French foremen who were recently expelled are not reinstated.

At Rotterdam the post, telegraph, and telephone employés are threatening to strike.

The Ironworkers' Strike.—Messrs. Dick, Kerr & Co., of Preston, have intimated that some parts of their electrical works may shortly have to close owing to the ironworkers' strike.

Industrial Council for the West.—The *Bristol Times* of September 24th reports a meeting of representatives of electrical undertakings and of the Unions of workmen engaged in the undertakings, to form a District Council under the National Joint Industrial Council for the Electricity Supply Industry. The area included was Gloucestershire, Somerset, Hereford, Wilts, and a portion of Devonshire. Mr. H. Faraday Proctor, engineer to the Bristol Electrical Committee, was elected to the chair, after the Lord Mayor had welcomed the representatives, and explained that they were met as representatives of No. 6 Area, there being 12 districts for the whole country.

Mr. C. F. Smith, representative of the Ministry of Labour, said that it had been the experience of the National Joint Industrial Councils that there was a necessity for devolution and the formation of District Councils, as there were many things which could not be dealt with on a national basis, but required knowledge of local conditions. The Ministry of Labour did not set up the Councils, but was willing to give any help it could. The Councils were autonomous and self-governing bodies, which managed their own affairs.

Mr. A. Hawker (General Workers Union), moved that a District Council be appointed; Mr. D. Facey (Electrical Trades Union), seconded, and it was carried. A resolution was also passed approving of the area as formed by the National Council; and it was agreed that the first meeting of the Council should be held in Bristol.

The Council is to consist of 12 representatives of each side, and must meet once in three months, or as often as necessary.

A Committee was appointed to draft the constitution.

An Excellent Electrical Record.—In a letter to Mr. Arthur Goodwin, of C. A. Vandervell & Co., Mr. F. Lionel Rapson states that his Rolls-Royce car is about to start on an official 10,000-mile tire test under R.A.C. supervision; the same C.A.V. outfit is still in use on this car as was originally fitted, with a mileage of 117,000, and, during the entire mileage, 73,000 of which were on war work, he has never been held up for a single moment due to electrical troubles.

Trade Announcements.—The Electrical Alloy Co., of Morristown, New Jersey, have opened a British Branch at 5, Chancery Lane, W.C. 2, under the management of Messrs. Williams & Pell; they are makers and suppliers of high-resistance wires and ribbons, known as Calido, Rayo, Comet, Phenix, Ideal, and Lucere, also of pure nickel, magno-nickel for sparking plugs, and grade A Monel metal.

Messrs. Babcock & Wilcox, Ltd., advise us that the new address of their Manchester local office is Victory Buildings, 230, Deansgate, Manchester. Telephone number, City 3112. Telegraphic address, "Babcock, Manchester."

Messrs. Sinclair, Paget & Co., electrical engineers, late of 235, High Holborn, W.C., have now taken over the Ashdown Electrical Co., of 8, New Inn Yard, Shoreditch, E.C. 2, which will in future be their only address.

Messrs. Bedbrook & Seddon left Dacre House, Victoria Street, on October 1st, and their new address will be 39, Victoria Street, S.W. 1. Telephone, Victoria 6720. Telegrams, "Drosseless" (Vic.), London. They are going into partnership with Mr. J. A. H. Bedbrook, who has been established there for 18 years. The style of the business will still be Bedbrook & Seddon. They are opening a branch office in Southampton.

The address of the Hotpoint Electric Heating Co. is incorrectly given in the London Telephone Directory. They are carrying on operations at 38, Poland Street, and have no connection with anybody at 116, Charing Cross Road, W.C.

In the reference, last week, to the business of the Gardy Co., it was stated that the company had extensive works at *Argentine*, Paris. For Argentine please read Argenteuil.

Germans in Argentina.—The *Times* states that commercial circles in Buenos Ayres are commenting upon the activity of the Germans in Argentine commercial life.

Liquidation.—New Peto and Radford Accumulator Co., Ltd., and Peto & Radford, Ltd.—Winding up voluntarily. Liquidator in both cases, Mr. F. G. Hart, 12, Heddon Street, Regent Street, W. Meetings of creditors, October 2nd.

Trade with Czecho-Slovakia.—Czecho-Slovakia, which includes Bohemia, is rich in raw materials, and possesses some of the most important industries in Europe. It is estimated that about 80 per cent. of the mines and industrial businesses of the old Austro-Hungarian Empire are now within the boundaries of the Czecho-Slovak Republic. It will thus be clear that when more stable economic conditions have been established, the Republic will become an important market for British trade.

Information regarding trade between this country and Czecho-Slovakia is being collected at the Department of Overseas Trade, and the *Board of Trade Journal* publishes an article thereon. In that article it is stated that most of the industries in Czecho-Slovakia are at present organised by the Government into industrial syndicates. These syndicates are controlled by the State; that is to say, there is a Government representative on the committee of each syndicate. The syndicate includes all the traders in Czecho-Slovakia of its particular branch, and in cases where the syndicate undertakes commercial transactions it is backed by the whole trade. These syndicates will, however, shortly cease to exist, as the policy of the Minister of Commerce is to free industries from Government control as far as possible.

Negotiations as to prices should be made direct with individual firms and not with the industrial syndicates. Before goods can be imported into Czecho-Slovakia, an import licence must be obtained by the Czech importer through the syndicate of the trade concerned from the Import and Export Commission at Prague. Each application for an import licence is considered on its merits, first by the industrial syndicate, and then by the Import and Export Commission at Prague. The rate of exchange and the needs of Czecho-Slovakia for the particular class of goods for which an import licence is required are taken into consideration. There are therefore no rules determining the grant of import licences, but for the guidance of intending exporters to the Czecho-Slovak Republic, it should be noted that as a general rule an import licence will not be granted if the importer has to pay in foreign currency, either cash down or within six months. If the shipment is to be paid for in foreign currency in one or two years, an import licence will generally only be granted for a part of the order, if it is a big one. An import licence for the total amount of the order will be granted to firms trading on the basis of exchange of goods, or if the exporter in this country accepts payment in Czecho-Slovak kronen to remain to his account in Czecho-Slovakia, transferable, of course, in that country, but not outside. It is, however, often possible to transfer the account through the National Provincial and Union Bank of England, which acts as agents for the Central Clearing Bank of Prague, to British firms wishing to pay for goods imported from Czecho-Slovakia. In this connection it should be noted that the Government scheme of export credits described in the *Board of Trade Journal* of September 11th extends to Czecho-Slovakia. Full particulars can be had on application to the Exports Credits Department, 10, Basinghall Street, E.C. 2.

There are a large number of goods the import of which is prohibited. This list is being revised from week to week. Firms interested should obtain particulars either from their customers in Czecho-Slovakia, the Department of Overseas Trade, or the Czecho-Slovak Legation, 9, Grosvenor Place, S.W. 1. The Department of Overseas Trade is prepared to supply, or to obtain, particulars as to importing firms in Czecho-Slovakia, which are believed to be reliable.

Japanese Electrical Industry.—A new Japanese monthly journal *The Trans-Pacific*, printed in English and Japanese, which has just reached this country contains, *inter alia*, an interesting article by the Japanese Minister of Communications on the development of the electrical industry. During the ten years 1907-1917, the capital invested in electrical undertakings of all kinds, both in operation and projected, in Japan, increased by 230 per cent., reaching £76,000,000 in 1917. This figure is three times the amount of capital investment in mining—the oldest of Japanese enterprises—and compares very favourably with the £112,000,000 expended in railways. The growth of the electrical industry in Japan has been chiefly due to the development of the great water power resources of the country, but the first enterprise which was begun in 1887 was the establishing of a 75 KW. generating plant by the Tokyo Electric Light Co. for supplying electric light to the city. This was followed in quick succession by similar plants in Kobe, Osaka, and other towns, so that by the end of 1890 the total capacity in the country amounted to about 1,500 KW. The next year, however, saw the establishment of the first hydro-electric enterprise in Japan, when the Kyoto municipality utilised the water of the drainage system from Lake Biwa to the city, a distance of about seven miles, and provided four watermills each of 120 H.P., and two dynamos of 80 KW. each.

Another landmark was the opening of the first electric tramway in Japan in 1895, also at Kyoto, and thereafter the industry developed by leaps and bounds. With the increase in generating capacity the transmission of current over long distances was undertaken, with such marked success that in November, 1914, the Inawashiro Hydro-Electric Co. carried out the transmission of electric power at 115,000 volts over a distance of 140 miles.

The statistics show that in regard to generating capacity, steam-electric plant increased by 377 per cent. in the ten years, while water-power electric plant advanced by 1,223 per cent. Whereas in 1907 the electricity generated by water power was about half that by steam power, in 1917 the position was reversed. In view of this development in the hydro-electric industry the Japanese Government has realised the urgent necessity of investigating the water-power resources available for industrial purposes, and it has started investigations with regard to available water power which can be used for over 185 days in a year during the five years from 1918. Taking into account power already being used or proposed to be used, it is estimated that the total water power in Japan will reach over 8,500,000 H.P.

With the development of the hydro-electric industry came a much wider field of utility, as in addition to lighting and traction demands there is now an ever-increasing demand for power for industrial undertakings. At the end of 1917 the number of motors supplied by electrical companies was 67,000, aggregating 314,000 H.P., an increase of 1,600 per cent. compared with 1907. In addition 19,000 motors were supplied to Government works and factories for their own use, bringing the total up to 86,000, distributed among various industries as follows:—

Enterprises,	No. of motors.	H.P.
Dyeing	14,025	119,086
Machinery making	18,098	210,485
Chemicals	7,424	134,957
Food and beverages	29,202	69,635
Mining and refining	4,870	184,041
Others	12,381	76,369
Total	86,000	794,523

Great expansion has taken place in regard to electric lighting. At the end of 1917 the total number of electric lamps in Japan was 10,320,000, of 123,000,000 total C.P., which works out at 99 lamps for every 100 houses, and 18.4 lamps of a total C.P. of 218, per 100 of the total population.

About one-third of the 10,320,000 lamps were distributed among the six largest cities of Japan, Tokyo, the capital, accounting for 1,631,212 and Osaka for 763,552.

Important progress also has been made in the electric tramway systems of the country. The total mileage of tramways in 1917 was 1,422 miles, an increase of 390 per cent. in ten years, while the number of cars increased by 210 per cent., reaching 4,539 in 1917. The total mileage run was 119,960,000 miles, and 822,500,000 passengers were carried. As in other countries, however, the cars are always crowded, and there is an urgent need in all the principal cities of Japan for greater transportation facilities.

The Exports Credit Scheme.—The following announcement by the Board of Trade embodies a previous announcement on the subject of the export credits scheme, published on September 5th, together with certain alterations and additions bringing that announcement up to date:—

The Government are prepared through the Export Credits Department of the Board of Trade to consider applications for advances up to 80 per cent. of the cost of the goods to the seller (including freight and insurance and the commission paid to the department by the seller), in respect of exports to Finland, the Baltic Provinces (Latvia, Esthonia, and Lithuania), Poland, Czechoslovakia, and Jugoslavia, the areas in Russia to which the scheme for insurance against abnormal commercial risks applies.

Any variations which may be made from time to time in the countries to which the scheme relates will be announced.

Advances will be made subject to the following conditions:—

1. The bills of lading are to be surrendered to the purchaser against his acceptance of a bill of exchange in sterling drawn by the seller for the full amount of the invoice at a tenor conforming to the agreed length of credit and against the deposit by the acceptor of security (see the next paragraph). The Government will release the drawer from any recourse against him for the amount of the advances made except in the case of misrepresentation by such drawer.

2. The purchaser must agree to take up the bills of lading against a deposit of currency which, calculated on the basis of the market exchanges, will be the equivalent of the amount of this draft plus a margin (usually 15 per cent.), which value will have to be maintained. This deposit must be made with the department's agents in the country of purchase, and will be held as security for the due payment of the bill of exchange. The relative insurance policies will be retained as additional security.

3. The department will consider proposals for the deposit of produce or securities instead of currency, and in certain cases for the deposit of fixed amounts of currency.

4. When the advance is needed, the shipping documents must be accompanied by a letter of guarantee from an approved bank of the country of purchase or elsewhere, stating that the bill of exchange will be accepted and the deposit of security made upon the first presentation of the documents to the buyer, and undertaking that the value of such security will be maintained. Applications accompanied by a banker's guarantee of sterling payment of the bill at maturity will receive preferential consideration.

5. For the convenience of exporters the department is prepared to receive applications, and if so decided, provisionally to sanction advances prior to the shipment of the goods. In such cases a limit of time must be stated within which the shipping documents, &c., will be produced and the advance taken.

6. The advance made by the department will be a first charge upon the proceeds of the bill and security, but, if such proceeds are less than the cost (including freight, insurance, and commission paid by the seller to the department), the loss represented by the difference will be shares between the department and the drawer of the bill, the share of the department being in the proportion which the advance bears to the amount of such cost, freight, insurance, and commission.

7. The credits will be granted for such periods as the department may determine in each case at the time of application for the advance.

8. Advances will not be made for the export of raw materials or of surplus Government stores, and preference will be given to the finance of goods where the larger part of the cost is due to manufacture in this country.

9. All applications must be passed to the department by the bankers of the seller, whose recommendation must be attached.

10. After collection of an amount equal to the cost (including freight, insurance, and the commission paid to the department by the seller) the bill of exchange and any relative security will be transferred to the seller if payment of the full amount has not been made.

11. At any time after the maturity of the bill or after any default the department will be entitled to close a transaction and transfer the bill of exchange and relative security to the seller, who will bear his proportion, as indicated above, of any loss incurred.

12. Interest will be calculated at the rate of 1 per cent. above the Bank of England rate from time to time ruling, with a minimum of 5 per cent. per annum, and will be payable by the purchaser in accordance with clauses to be inserted in the bill of exchange. The purchaser must agree to increase at the end of each six months the security deposited so as to cover the amount of such interest.

Commission to defray the expenses of the department and to form a fund to meet any losses will be payable by the seller at the time the advance is taken. He may, however, include this commission in his invoice and add same to the amount of his cost, freight, and insurance when calculating the amount of the advance.

The rates will not be less than 3 per cent. for the first year; 4 per cent. for the second year; 5 per cent. for the third year, but in the event of the bill of exchange being paid before maturity, proportionate rebate will be allowed to the purchaser. In no case, however, will the charge be reduced below 2 per cent.

13. The conditions set out above may be modified at any time or in special cases.

Forms for use by applicants, and copies of this announcement, can be obtained from the Export Credits Department. 10, Basinghall Street, London, E.C. 2.

Board of Trade Changes and Economic Questions.—The President of the Board of Trade has established an internal Administrative Council which includes the Parliamentary and Permanent Secretaries and the heads of the chief administrative departments. The Council will meet regularly and frequently to deal with current business involving questions of policy. Sir H. Llewellyn Smith, G.C.B., Permanent Secretary to the Board of Trade, has been appointed by His Majesty's Government to the post of economic adviser with reference to the larger national and imperial economic questions, especially for the present those arising out of the peace settlement and the transition to normal conditions. He will retain clos. connection with the Board of Trade in the capacity of vice-president of the Administrative Council, over which he will preside in the absence of the President of the Board of Trade. In order to fill the vacancies caused by the appointment of Sir H. Llewellyn Smith and the transfer of Sir William F. Marwood, K.C.B., to the Ministry of Transport, the President of the Board of Trade has appointed Mr. S. J. Chapman, C.B., C.B.E. (Senior Assistant Secretary, General Economic Department), and Mr. H. A. Payne, C.B. (Comptroller of the Companies Department), to be Joint Permanent Secretaries of the Board of Trade. The Administrative Council referred to above is quite distinct from, and in no way supersedes, the Board of Trade Advisory Council on which manufacturers, traders, and labour are represented.

Bankruptcy Proceedings.—H. W. Wilson, consulting engineer and director, Liverpool.—Trustee, Mr. L. Nicholas, released September 12th.

LIGHTING AND POWER NOTES.

Ascot.—Proposed Price Increase.—The Ascot District Gas and Electricity Co. has applied to the B. of T. for authority to increase its charges to a price that will ensure its shareholders a dividend of 4¾ per cent.

Aylesbury.—Electric Cooking.—The T.C., in order to test the consumption of energy of electric ovens, has decided to hire different types of oven.

Cardiff.—Price Increase.—The price of electricity is to be increased to 75 per cent. above pre-war rates. At present consumers are charged 50 per cent. above the rates of 1914.

Colne.—Accident.—A serious accident occurred on the evening of the 24th ult. at the electricity works, the top of a cylinder being blown off and considerable damage caused. Arrangements for a temporary connection with the neighbouring town of Nelson were made. It was reported that the lighting supply might have to be curtailed.

Colwyn Bay.—Year's Working.—There was a net loss of £1,618 on the electricity undertaking for the past year.

Price Increase.—The electricity charges are to be increased by 33⅓ per cent.

Continental.—Spain.—The Compania General de Electricidad de Granada has lately secured a concession to erect plant to utilise the water power of the River Genil, near Puente Genil, to generate electricity.

A Bilbao company is about to set up smelting works in the Provinces of Lugo and Corogne. It has bought the Wagner hematite iron mine and the Villablino mines, and will lay down a 70-km. railway. The blast furnaces and the foundry will be built for an output yearly of 600,000 tons of pig iron and 500,000 tons of steel. Electricity will be used throughout, up to 50,000 H.P., being supplied from three falls secured by the company in the Provinces of Leon and Orense.

Denmark.—A scheme for the enlargement of the electrical installation of Copenhagen has been drawn up by the municipal authorities. The work will take two years to complete, and the estimated outlay is 4,900,000 kroner.

Coventry.—Loan.—The T.C. is applying to the Ministry of Health for sanction to a loan of £40,000 for extension of mains.

Price Increase.—The existing charges for lighting are to be increased by 66⅔ per cent. from October 1st, 1919, such increase to be in lieu of 20 per cent. increase made in November last; also the charge for the hire of motors is to be increased by 50 per cent.

Haslingden.—Price Increase.—The T.C. has advanced by a further 25 per cent. the cost of energy for heating and lighting, making 75 per cent. increase on pre-war rates. Energy supplied to tramways has been increased ½d. per unit, making the total charge 2½d.

Hastings.—E.L. Charges.—The T.C. has received an order from the B. of T. stipulating that the price of electricity shall not exceed 10d. per unit except by variation from the Board, nor more than sufficient to enable the undertaking to be carried on without loss.

London.—St. Pancras.—The accounts show that the loss on the year's working to March 31st, 1919, has been £20,239. The actual deficit at that date is, however, reduced by the balance of £4,150 brought forward from previous profits, but £4,000 of this represents the working balance which it is usual to retain in the revenue account.

Poplar.—The report for the year ended March 31st last, shows total units sold, 21,526,200, an increase of 1,021,176; net income, £133,351, an increase of £25,984; working expenditure, £94,812, an increase of £20,133; gross profit, £38,539, after payment of interest, £12,830, repayment of loans, £16,204, and special charges, £521, there remained a net balance of £8,983, which with £3,777 brought forward, leaves a net available surplus of £12,760.

Ex-Service Employes.—The Westminster E.S. Corporation has signified its intention to employ not less than 5 per cent. of disabled ex-service men, in accordance with H.M. the King's Proclamation.

Battersea.—The charge for lighting is to be increased from 5d. per unit plus 10 per cent. to 5d. plus 20 per cent. Meter rent is to be increased from 1s. to 2s. per quarter; both increases to take effect as from the next reading of the meters.

Hammersmith.—The estimated increase in the cost of public lighting for the remainder of the financial year is as follows:—Electricity, £665; gas, £885; or a total of £1,550. A certain main is to be extended to Wood Lane, at an estimated cost of £150, the estimated revenue from the supply being £65 per annum.

The quotation of the Pirelli General Cable Works, Ltd., for the supply of 1,000 yards of 0·1 sq. in. and 2,000 yards of 0·05 sq. in. L.T. cable, which is required to maintain the stock of cable, has been accepted.

Further to preceding reports, in reference to the scheme for the dismantling of boilers Nos. 2, 3, and 4 and the supply of a larger boiler, the space taken up by these three boilers is required for the erection of the new boiler already delivered, and the offer of the Foster Construction Co. for removing the three boilers in question has been accepted. It is necessary that this work should be proceeded with forthwith, to ensure the least possible delay in erecting the new plant.

Madagascar.—New Hydro-Electric Installation.—The installation of water and electric light systems for Tamatave, the principal port of Madagascar, is under consideration by the authorities, and the project has the approval of the Governor-General. The electricity is to be furnished by waterfalls situated 10 to 15 miles west of Tamatave, on the Ivondrono River. In view of the capacity of these falls, estimated at 3,000 H.P., it is agreed that in addition to the municipality of Tamatave the colony of Madagascar and dependencies should also become interested, and that this water-power should be made available in order to furnish

power for the general future needs of the colony in connection with such important undertakings as the electrification of the railway from Tananarivo to Tamatave, a distance of 229 miles, electro-metallurgical and electro-chemical industries, &c. It is proposed, therefore, that the colony undertake the harnessing of this water-power, which would necessitate the building of a dam, reservoirs, canals, and a power plant. The obligation of the municipality will thus be reduced to the installation of two groups of turbines to furnish 500 KW. of A.C., power cables, transformers, and the distribution of water in the town of Tamatave. The colony's expenses in this connection will, it is estimated, be 625,000 fr., and those of the municipality of Tamatave 1,225,000 fr. —*Board of Trade Journal.*

Manchester.—LOANS.—The S.C. has been recommended by the E.C. to approve of the borrowing of £50,000 for distribution station plant. A public inquiry is to be held shortly into the million-pound scheme for erecting a large generating station at Barton.

Pudsey.—PRICE INCREASE.—The price of electricity for lighting purposes has been advanced to 6d. per unit, and for power to 3d. per unit.

Redditch.—YEAR'S WORKING.—The accounts for the year ending March 31st, 1919, show that the income amounted to £23,586, whilst the expenditure was £22,714, leaving a profit of £872. A sum of £1,500 was put aside as reserve for capital repayments. The cost of generation and distribution was £17,500. The loans outstanding amount to £64,826.

Rotherham.—PRICE INCREASE.—The T.C. has increased the price of electricity for power and heating to 75 per cent. on pre-war charges, and for lighting to 40 per cent., from the September meter readings.

Southampton.—PRICE INCREASE.—The T.C. has increased the price of electricity for lighting, power, and heating, by another 40 per cent., after the meter readings for the September quarter, making the war advance 80 per cent.

Todmorden.—LOAN SANCTION.—The M.H. has sanctioned the borrowing of £7,500 in connection with a bulk supply of electricity from the Yorkshire E.P. Co., the municipal electricity undertaking having proved unremunerative.

Twickenham and Teddington.—PRICE INCREASE.—The E.S. Co. has increased the rental of electricity meters by 2s. per quarter, from the quarter ending December. The price of electricity through slot meters and on the weekly payment system is to be increased.

Willesden.—NEW PLANT.—The U.D.C. has authorised the electrical engineer to negotiate with the General Electric Co. for the supply of a new 500-KW. transformer, in lieu of the existing 150-KW. transformer at Salusbury Road sub-station, an allowance being made for the latter plant.

HOUSING SCHEME.—The Housing Committee has again considered the report of the electrical engineer as to the lighting of the roads and houses on the Brentfield Estate, and also an estimate submitted by the Gas Light and Coke Co. for the fitting of the houses for lighting, cooking, and heating by gas. After careful consideration of the alternative methods, the Committee has adopted the principle of lighting the roads and houses by electricity.

Wolverhampton.—M.H. INQUIRY.—The M.H. has held an inquiry into the application of the T.C. for sanction to borrow £6,747 for the purchase and adaptation of premises in Red Lion Street for the purposes of the electricity undertaking.

TRAMWAY AND RAILWAY NOTES.

Barrow-in-Furness.—TRAMWAY SALE.—A special meeting of the T.C., on September 23rd, considered the purchase from the British Electric Traction Co. of the electric tramway undertaking. A resolution to purchase was carried unanimously, and a further resolution was approved that application be made to the B. of T. for consent to the Corporation borrowing a sum not exceeding £120,000 in respect of the purchase and development of the undertaking.

Blackpool.—YEAR'S WORKING.—The Corporation tramway receipts from April 1st to September were £25,000 in excess of last year, which was also a record.

Continental.—FRANCE.—The report of the Paris Metropolitan for 1918 shows that as a result of the eight-hours' day, introduced in April, the company will be obliged to employ 1,000 additional employés; at the end of 1918 the staff numbered 4,627. The total length of line remains unchanged at 78·75 km. since April, 1916. Total receipts amounted last year to 74,774,850 fr., and expenditure to 45,825,290 fr., compared with 71,390,720 fr. and 36,361,290 fr. respectively for 1917. The lower net revenue increased the ratio of expenses to receipts from 50·93 per cent. in 1917 to 61·28 per cent. The service, which was materially curtailed during a large part of the war, was so improved last year that the train-mileage nearly rose to the pre-war level. Net earnings per kilometre worked out at 48,323 fr., compared with 142,195 fr. in 1917. Actually, last year's earnings were insufficient to pay the fixed charges, and the net result was a deficit of over 3,000,000 fr. First-class receipts formed 21·21 per cent. of the total, a higher figure than in previous years; second-class passengers yielded 52·68 per cent. of the gross receipts (against 54·06 per cent. in 1917). These figures only apply to single fares, return tickets yielding 25·18 per cent. of the gross receipts. A dozen station agents sold over six million tickets apiece, among which were Vincennes, 11,307,099; Porte Maillot, 10,770,907; Bastille, 9,739,749; Gare du Nord, 9,396,053; and Gare de l'Est, 9,057,430. Average receipts per passenger were ·177 fr., of which the City of Paris took ·06 fr.

BELGIUM.—It was recently announced that a Commission had reported in favour of the electrification of the Belgian State Railways, and that the conversion was to be carried out on the H.T., D.C. system. It appears that several members of the Commission have been visiting this country to see what has been done here, and it seems that they were particularly interested in the electrified suburban lines of the London and South-Western Railway, on which routes the stations are about a mile and a half apart. This corresponds nearly with the station-spacing on the Brussels to Antwerp line, which it is expected will be the first to be converted. The L. & S.W. system also affords a good example of rapid acceleration after stops and a high average speed, the motor equipment per train being very powerful.

It is proposed to establish an electric tramway between Vise and Vivegnis, the terminus of the Liège system of tramways. This would serve to connect the latter town with Vise, which, owing to the completion by the Germans of the bridge across the Meuse, will create a new, short, direct route between Germany and Brussels. It is intended later on to build five other lines, linking Vise with Maestricht, Tongres, and other towns of importance in the district. A co-operative society, with an estimated capital of 2,000,000 to 3,000,000 fr., is in process of formation, with a view to providing the necessary funds for the guarantee which it will be necessary to deposit with the Government for the concession. It is also probable that the power required for the tramway system will be utilised to supply electric light to some of the towns and villages served by the tramway.—*B. of T. Journal.*

ITALY.—The Minister of Public Works has established the rule that henceforth no permission will be given for the construction of new steam-traction railways. Only electric railways are to be built.

SPAIN.—A company has been formed at Madrid, under influential auspices, and with the title of the Sociedad de Electrificacion Industriel, with an initial capital of 5,000,000 pesetas (£200,000), for the purpose of investigating various schemes for the conversion of railways to electric traction. Among those interested are the principal hydro-electric companies, the Altop Hornos of Vizcaya, the Constructora Naval, and the Banco de Vizcaya.

NORWAY.—It is reported from Narvik that engineers are examining the proposed route for the overhead line in connection with the projected conversion to electric traction of the Ofoten railway. The scheme contemplates the obtaining of power from the Swedish hydro-electric works at Porjus. Questioned on the subject, Mr. Hansen, general manager of the Swedish State hydro-electric works, states that no negotiations between the responsible Swedish and Norwegian authorities have taken place, although informal discussions have proceeded. But the possibility of supplying Norway from the Porjus works is slight, as contracts already exist, not only for the output from the existing plant, but also for the output from the extensions now in progress.

Dewsbury.—EXTENSION OF TIME.—The T.C. has applied to the B. of T. for an extension of time until July 29th, 1921, for the completion of the tramways authorised by Section 5 of the Act of 1915.

Dumbarton.—YEAR'S WORKING.—At a meeting of the Tramways Committee, Mr. George Balfour, M.P., said it was impossible for the company to bear any increased expenditure without an increase of the present maximum fares. The receipts for the year were £41,821, compared with £38,150 in the preceding 12 months, while expenditure showed an increase of £7,511. After payment of interest the available balance was £10,813.

Fleetwood.—LICENSING.—The U.D.C. has been served with notice of appeal by Blackpool and Fleetwood Tramroad Co. with respect to the decision of the Fleetwood magistrates that the cars, &c., of the company should be licensed by the Fleetwood U.D.C. There seems likely to be costly litigation in a matter where only a few shillings per annum are at stake.

Greenock.—The unification of the tramway system was discussed at the last meeting of the T.C. on a motion that the Council exercise its option in the lease and take over the system in 1921. The motion was defeated, in view of the fact that there is already a Committee considering the matter.

Haslingden.—THROUGH RUNNING.—Haslingden and Rawtenstall Tramway Committees have arranged for a resumption of through running over the long stretch between those towns. Accrington Corporation contemplates running several new cars which are now on order.

Nelson.—LOAN.—The T.C. has decided to make application to the B. of T. for powers to borrow £25,000, the estimated cost of a new tramway-shed.

London.—Accidents.—Late on Friday night, last week, an L.U.T. tramcar ran into a cart at Kew Bridge: the car was able to proceed after nearly an hour's delay. On Saturday afternoon a tramcar failed to take the points at Kew Bridge, and was derailed. Further along the same road a trolley-pole broke off a second car, which had to be towed. A steam wagon also broke down on the tramway line. These accidents happened within a few minutes of each other, and considerably disorganised the traffic.

On Monday morning an L.U.T. tramcar was derailed in the Chiswick High Road. As a result of the railway strike and the consequent increased motor traffic on the roads, difficulty was experienced on Monday morning in regulating traffic in Chiswick and Brentford High Roads. The relaying of the tramway lines in these roads added to the difficulty.

The Embankment service of the L.C.C. Tramways was held up for some time on Tuesday owing to the breakdown of a car at Westminster.

Two motor-buses collided in London Road, S.E., on Saturday, and one collapsed on the rails, holding up the congested L.C.C. cars for half a mile in every direction for 20 minutes.

Electricity failed for half-an-hour on Sunday night, and all tramway-cars between Ealing and N.W. London were held up.

An L.C.C. tramcar caught fire, on Thursday last week, in Southwark Bridge Road, and passengers were compelled to alight. Two persons were injured in a tramcar and omnibus collision, on Friday last week, in Jamaica Road, Bermondsey.

Newcastle-upon-Tyne.—Time Extension.—The B. of T. has extended the time until August 7th, 1920, of the Newcastle-upon-Tyne Corporation Act, 1914, for the completion of the tramways.

North Shields.—Accident.—A serious accident occurred on Saturday evening, resulting in injuries to 16 persons. The tramcar was coming down the very steep declivity, Borough Bank, when it got out of control and dashed down hill towards the river. At the bottom of the hill is a sharp turn, and here the car, which was full of passengers, left the rails, smashed an electric standard, ran into a wooden erection, and turned over. The car and wooden building were completely wrecked.

Preston.— Electric Vehicles.—The M.H. has sanctioned the borrowing of £2,657 for the purchase of two electric tipping wagons by the Cleansing Committee.

Rhondda Valley. — Proposed Extensions. — The Rhondda Tramways Co. has decided to promote a Bill in Parliament for the extension of the tramways from Penrhiwfer to Gilfach Goch, and from Tonyrefail to Pontyclun.

Stoke-on-Trent.— The Corporation has decided to purchase all the tramways, light railways, and omnibus services in North Staffordshire belonging to the Potteries Electric Traction Co. and the North Staffordshire Tramways Co. for £737,890. Payment of principal and interest at 5 per cent. is to be spread over a period of 30 years.

Sunderland.—New Cars.—Six new tramcars of the standard type are to be purchased. This will bring the total number of cars up to 82, and will relieve the overcrowding which at present exists.

Swansea.—Time Extension.—The Corporation Light Railways (Extension) Order, 1914, for the completion of certain sections of the light railways has been extended for one year from August 28th, 1919.

Walsall.—Year's Working.—The accounts for year ending March 31st, 1919, show a total expenditure of £45,921, and a net revenue of £21 003. The total revenue was £66,925. £4,478 was relegated to the sinking fund. Number of passengers, 12½ millions; number of units used, 1,164,518.

TELEGRAPH AND TELEPHONE NOTES.

Bolivia.—Early in May, this year, the wireless station erected at Cobija was completed and ready for service. The station was erected by the Marconi Wireless Telegraph Co.

Brazil.—Work on the telephone lines between the cities of the coast and the interior is being rapidly carried on, and telephone communication has already been established between Sorocaba and Rio de Janeiro.

Costa Rica.—The National Government has ordered a high-power wireless telegraph installation from the United States in order to foster domestic commerce by means of rapid communication.

Cuba.—A wireless telegraph station on the Central Chapara sugar factory grounds is being erected. According to Press reports the station was to be in operation in September.

Greece.—The Postmaster-General has made arrangements with the Eastern Telegraph Co. under which telegrams paid at triple rates will receive priority of treatment over other private telegrams on the cables between this country and Greece, the Greek Islands, and Turkey; but, in view of the pressure now prevailing on the lines, it must be understood that a rapid service cannot be guaranteed. The service came into operation on September 26th. The charge is 1s. 4½d. a word in the case of Greece, Corfu, Crete, Euboea, and Poros, and 1s. 6d. in the case of Turkey and the Greek Islands not already specified. The word "Urgent" must be inserted before the address, and paid for as an extra word.

Haiti.—The authorities in charge of the wireless station at Port au Prince state that the station is now ready to accept commercial traffic for all parts of the world.

Italy.—Messages from Reggio di Calabria report a cyclone in the district of Palmi on the coast north of the Straits of Messina. Telegraph wires are down, and communication southward is interrupted.

Nicaragua.—Efforts are being made to arrange for a more powerful wireless telegraph station to replace the outfit now being used by the United States Marine Corps at Marte Field, Managua.

P.O. Telephone System.—The P.M.G. intends, says the daily Press, to send a special commissioner to the U.S.A. in connection with the telephone system as was announced in these columns some time back.

Sir Robert Hadfield, F.R.S., in an interview with a newspaper representative last week, is reported to have said that the P.M.G. has been discussing the telephone system with Dr. W. Eccles, of the London City and Guilds Technical College, and also that Major-General G. O. Squire, of the U.S. Army Signal Corps, has been trying to help the Post Office.

South Africa.—For the first time in the history of the Union Post Office the actual cash receipts, according to the report of the Postmaster-General for 1918, have exceeded £2,000,000. The actual figures are £2,017,040 for 1918, an increase of £103,409. Towards this satisfactory increase telegraphs contributed £60,390, telephones £38,721, and postal services £4,298.—*B. of T. Journal.*

Telegraph Rates.—On October 1st the Eastern Telegraph Co.'s rates between the United Kingdom and Japan, Chosen, Formosa, and Japanese Saghalien will be reduced as follows:—Ordinary telegrams, 3s. 4d. per word; deferred telegrams, 1s. 8d.; Press telegrams, 1s. 1d.

Telephone Volunteers.—Telegraph and telephone exchange linemen and wiremen are urgently required for railway work during the strike. Applications should be made to railway stations, or to the Chief Signal Officer, Horse Guards, Whitehall.

Trunk Calls.—In trunk telephone calls, owing to the strike, the Food Ministry and its branches have absolute priority over private subscribers.

Underground Cable Extensions.—The Metropolitan Borough of Hammersmith has approved extensions of certain underground telegraph lines.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Sydney.—November 10th. City Council. Supply of electric motors. Particulars from Electric Lighting Department, Town Hall, Sydney.

October 13th. City Council. Three 2,000-K.V.A., 33,000/5,000-volt, transformers. Electric Lighting Department, Town Hall, Sydney.

December 19th.—Metropolitan Board of Water Supply & Sewerage. Centrifugal pumps, electric motors, &c., for the low-level pumping station, Marrickville. Offices of the Board, 341, Pitt Street, Sydney.*

Melbourne. — P.M.G.'s Department. January 20th, 1920. Automatic telephone switchboard at Collingwood. Schedule 1,583. (September 19th.)

December 3rd. Victorian Railways. Portable electric welding set and accessories. Secretary for Railways, Spencer Street, Melbourne.*

Bradford.—October 9th. Electricity Department. Two 1,500-KW. rotary converters, transformers, &c.; induced draught plant and chimneys, and three economisers. (September 12th.)

Dundee.—October 8th. Electricity Department. E.H.T. switchgear and concrete cell-work at the Carolina Port main generating station. Section "A," switchgear for one 5,000-KW. turbo-generator and six feeders; section "B," alterations and additions to present switchgear, for two 5,000-KW. turbo-generators, one feeder and one 500-KW. transformer. (September 19th.)

Edinburgh. — October 13th. Corporation. Electric lighting installation under the new housing scheme. (September 26th.)

India.—Lahore.—Electric Supply Co. Generating plant, two 1,000-KW. and two 500-KW., three-phase, 6,600-volt turbo-alternators, &c.; boilers, mechanical stokers, &c.; sub-station plant, H.T. and L.T. mains, &c. (September 5th.)

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development and Intelligence), London.

Lyons.—Société de Nouveaux Hotels. Electric lighting, electric bell and telephone installations, lifts, &c. M. l'Administrateur délegue de la Société, 10, rue des Marroniers, Lyons.—*B. of T. Journal.*

Madagascar.—March 1st, 1920. Directeur des Travaux Publics à Tananarive. Installation of electric station, with equipment, at Falls of Volobe, near Tamatave; erection of overhead transmission and distribution lines, and establishment of service in the city. Ministère des Colonies, Paris.

Paris.—October 6th. Administration des Chemins de Fer de l'Etat. Electrical and mechanical equipment for the extension to the Rouen generating station. Bureaux du Service électrique (Ie division), 43, Rue de Rome, Paris.

St. Helens.—October 4th. Electricity Committee. One 5,000-KW. steam turbine, with condensing plant and auxiliaries. (September 19th.)

Warrington. — October 7th. Electricity Committee. H.T. and L.T. lead-covered cable. (September 19th.)

Whitwood.—For supply and erection of a motor and gearing in connection with proposed alterations to sewage pumping engines at Whitwood Mere. Specification, &c., from Mr. S. Stead, Clerk to the Council, Whitwood Mere, near Castleford.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, October 3rd. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "The Deduction of Formulæ from Plotted Figures," by Mr. A. J. Paxman.
Friday, October 10th. Official visit and meeting. At the Shipping, Engineering and Machinery Exhibition at Olympia.

Salford Technical and Engineering Association.—Saturday, October 4th. At 7 p.m. At the Royal Technical Institute. Lecture on "Compressed Air for Shipyard Work," by Mr. G. Varley.

London Association of Foremen Engineers.—Saturday, October 4th. At 7 p.m. At Cannon Street Hotel. Paper on "Elimination of First Stretch in Steel for Reinforcing Concrete," by Mr. A. W. C. Sheif.

Electro-Harmonic Society.—Friday, October 10th. At the Holborn Restaurant (Venetian Chamber). At 8 p.m. First smoking concert.

Birmingham and District Electric Club.—Saturday, October 11th. At the Grand Hotel, Birmingham. At 7 p.m. Paper on "Thermo-electric Generators," by Mr. C. M. Walter.

International Shipping, Engineering and Machinery Exhibition.—Open until October 17th. At Olympia, West Kensington, W.

NOTES.

Health Councils.—The constitution of the Consultative Councils set up to advise the Ministry of Health is announced in the *Times* of September 29th. For England there will be four such Councils, to advise on (1) Medical and Allied Services, (2) National Health Insurance, (3) Local Health Administration, and (4) General Health Questions. The secretary will be Mr. Michael Heseltine, C.B., Ministry of Health, Whitehall, S.W. 1. The Councils will consist of 20 members each.

The Council on National Health Insurance will consider problems of approved societies' work arising in the administration of cash benefits.

Wales will have one Council of 30 members.

Fuel Economy.—On September 26th, under the Defence of the Realm Regulations, the Board of Trade made an order entitled "The Lighting, Heating, and Power (Emergency) Order, 1919," which states that all sky signs, illuminated facias, illuminated advertisements, and other lights used outside or at the entrance to any premises for the purpose of advertisement or display, and lights used inside any shop for the purpose of advertisement or display when the shop is closed for serving customers, shall be extinguished.

The Order does not apply to any public street light or any other light approved by the Chief Officer of Police as necessary in the public interest. It applies to the whole of Great Britain, and took effect on the day of issue.

On the same day an Order was made fixing the maximum calorific value of gas from public supply undertakings at 425 B.TH.U. gross, and requiring it to be supplied at full pressure only during the periods when its effective use was most required, the pressure being lowered at other times. This Order was entitled the "Gas and Coal (Emergency) Order, 1919," and was dated Sept. 26th.

A further Order—"The Coal and Fuel (Emergency) Order, 1919"—of the same date, was made by the Board of Trade for the purpose of maintaining the supply of coal and fuel for household purposes, and prohibited (except by consent of the Local Fuel Overseer) the purchase or supply of more than 1 cwt. of coal in any week for consumption in any premises coming within the scope of the Household Fuel and Lighting Order, 1919, or the purchase or supply of any coal where the stock available exceeds 10 cwt. The Local Fuel Overseer was authorised to transfer registrations for coal, or to cut off any supply of gas or electricity covered by the former Order, where there was reason to suspect abuse of the supply. This Order was brought into force on Saturday last, by order of the Controller of Coal Mines.

The Shipping, Engineering and Machinery Exhibition.—The following dates and particulars may be of interest to our readers:—The Exhibition is being held at Olympia, Addison Road, London, W., and will remain open until October 17th, from 11 a.m. to 9 p.m. daily, admission 1s. 3d., including tax. The secretary and organising manager is Mr. F. W. Bridges, and the offices are at 36-38, Whitefriars Street, London, E.C.4; Telephone: Central 5486; Telegraph: "Segdile ('Phone), London." Special visits of students, &c., are being arranged for at greatly reduced rates.

October 3rd.—Official visit of Municipal and County Engineers. Reception, 4.15 p.m.

October 4th.—Meeting of the Institute of Marine Engineers. 6 p.m. Paper, 7.15 p.m., by Captain W. P. Durtnall on "Electrification of Ships."

October 7th.—Meeting of the Institute of Marine Engineers. 6 p.m. Paper, 7.15 p.m., by Mr. C. Baxter, on "Developments of the Internal-combustion Engine."

October 9th.—Visit of the Institution of Mechanical Engineers. 4.30 p.m. Lecture, 7.15 p.m., by Captain H. Riall Sankey, C.B., R.E. (retired), M.I.Mech.E., M.I.E.E., on 'Wireless Telephony."

October 10th.—Visit of the Junior Institution of Engineers. Reception 4.15 p.m. Lecture, 7.30 p.m., by Dr. H. S. Hele-Shaw, D.Sc., LL.D., F.R.S.

October 14th.—Meeting of the Institute of Marine Engineers. 6 p.m. Paper, 7.15 p.m., by Mr. E. F. Spanner, on "Special Form of Ship's Keel with Due Regard to Bilge and other Pipes."

In the Kinematograph Theatre a technical and industrial programme has been arranged (no charge for admission), and films will be shown from 2 to 9 p.m. daily, which will include the following:—Marconi's Wireless Telegraph Co., Ltd., "Wonders of Wireless," and "Wireless in Warfare"; Siemens Bros. & Co., Ltd.. "Cable Manufacture"; Rownson, Drew & Clydesdale, Ltd., "Labour-Saving Plant."

The Electrical Development Association's Pamphlets.—The activities of "Eda" are making themselves felt in various directions, not the least important of which is the production of literature for the use of supply authorities. During the past month several excellent leaflets were issued. "Britain's Buried Treasure" (E.D.A. 16), naturally relates to coal and its economical use, and gives a list of the many ways in which electricity can contribute to home comfort in the guise of the "universal servant, with an eternal willingness to work and a passion both for efficiency and economy." "Light, Heat, Power without Flame, Smoke, Fire," is the title of E.D.A. 17, which deals with the same subject more generally, emphasising the advantages of carrying out the combustion of coal under scientific guidance in a central plant, and delivering the energy in the most convenient form that it can possibly assume. A little brochure called "The Land of Beautiful Reality," the first E.D.A. pamphlet printed in colours (E.D.A. 6), shows how the goddess electricity banishes dust and ashes, coal and grime from the household, and solves the problems of domestic help.

This week we have received a most useful publication—the unsolicited testimony of a householder to the economy, convenience, and comfort derived from the use of electricity for lighting, heating, cooking, washing, &c. (E.D.A. 23). This is an excellent testimonial, as it is the verdict of actual experience, and the variety of incidental economies and advantages resulting from the use of electricity is surprising even to the initiated. Any of these publications can be obtained from the Association at low prices.

Railway Electricians' Holidays.—The award has been issued of the arbitration inquiry into the claims of the Electrical Trades Union that the same holiday conditions already agreed to for workers in the general electrical undertakings of the London district should be applied to the men employed in the electricity departments of the railway companies operating in the London area. At the hearing it was contended by the railway companies that the men concerned formed part of the general body of railway workmen, and that their holiday conditions should be regulated by those governing the general body. The Court decided that the claim had not been established.—*Daily Telegraph.*

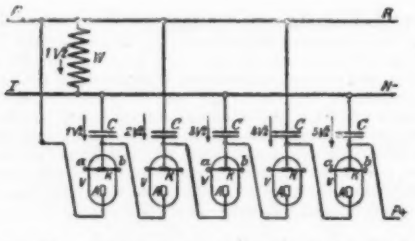
Standardisation in Sweden. — As a result of the initiative taken by the Swedish Elektro-Industry Association, negotiations were begun last May with the object of establishing an institution for the standardisation of electrical manufactures and installations. As a result of these efforts a Standardising Committee has been formed, consisting of six members of the Technological Association, two of the Municipal Administration, and one each representing the Electricity Works Association, the Royal Water Power Board, the State Railway Board's Electrical Department, and the Electrical Contractors' Association. The Committee has appointed a Sub-Committee of experts in the different branches to make proposals for standard regulations, and it is expected that plans for undertaking all standardisation work will be available by the end of 1920.

German Lamp Works Amalgamation. — Germany's principal electric lamp factories, the A.E.G. special branch and the Auer and Osram firms, are to combine, according to Press reports, as one company to fight foreign competition.

Electric Brass Furnaces.—At the June meeting of the American Institute of Chemical Engineers, the greater part of the programme was given to a symposium on electric furnaces. From these papers, says *Chem. and Met. Engineering*, it is learned that four years ago there was no electric brass furnace in commercial operation. To-day some 40 firms are using, or installing, 100 such furnaces; these range in capacity from 300 lb. to 1 ton. Five types of furnaces have thus far established themselves in practical use; of the direct arc type, only the Snyder has yet been used on copper alloys; this type is applicable only to true bronzes, or other alloys low in zinc, 5 per cent. being the probable limit. The chief advantage of the Snyder furnace is its adaptability to mechanical charging. A drawback is the single-phase arc load. The vertical ring induction (Ajax Wyatt) type is the most efficient in use of power; it uses up no electrodes, gives thorough mixing of the charge, with perfect temperature control, and has the steadiest electrical load. But, after a shut-down, it must be "primed" with previously-melted metal. Hence it is not well fitted for 10-hour runs, though it can be so used by keeping some current on and holding some metal molten overnight. This need for priming makes it difficult to change from one alloy to another; it is used chiefly on yellow brass. A drawback is that, so far, no refractory lining has been found that will stand the action of alloys containing over 3 per cent. of lead. It is well fitted for 24-hour runs on the same alloy. The least efficient in the use of power is the granular resistor, reflected-heat (Bailey) type; it does not mix the charge, but it has a steady electrical load, and, like the Ajax Wyatt type, it uses up no electrodes. Like that type, too, it is best fitted for 24-hour runs, though, again like the Ajax Wyatt, it can be used for 10-hour runs by keeping some power on through the night to maintain the furnace heat. Due to its heat storage and consequent sluggishness, it has poor temperature control. It can be used on any alloy; but it is better fitted for yellow brass than for the higher melting alloys; its chief advantage lies in its simplicity of operation. The stationary indirect arc (Rennerfeld) type compares fairly well in power consumption. It is more suitable for alloys low in zinc. It has had marked success in melting cupro-nickel, bronze, and silver at the Mint. The indirect arc type, with stirring of the melt (rocking furnace), is suitable for alloys of any zinc content. It has a low power consumption, and seems to be efficient in small as well as in large sizes; it has good temperature control, and it mixes the charge thoroughly. An advantage is that it can be readily charged mechanically. Its drawbacks are the single-phase arc load, and the possibility of an electrode breakage in rocking too early.

Generating H.T. Direct Current.—A new method is described in *E.T.Z.* of July 10th last, by which high D.C. voltages may be obtained by using alternating voltages of moderate values.

In the figure, W represents the alternator winding, C condensers, V vacuum valves with anodes A and hot kathodes K heated by cells applied at *a b*. Considering the first circuit C V, the condenser will be charged up to the maximum value, or $1 \cdot \sqrt{2}$, of the alternator voltage during the first half period. During the second half period the condenser is prevented from discharging by the valve and, the alternator voltage being reversed, a voltage of $2 \cdot \sqrt{2}$ will be reached between the valve terminals. This voltage is applied to the next condenser valve circuit, and so on, so that the voltages across successive valves will be $2 \cdot \sqrt{2}$, $3 \cdot \sqrt{2}$, $4 \cdot \sqrt{2}$, and so on. In this manner the voltage may be raised to the limit set by the insulation of the system. If current is taken from the last condenser, it is immediately recharged from the winding W. As this takes place with the aid of the preceding condensers, these must differ in size, so as to decrease in size with increasing voltage. Thus, the first condenser, which has the same voltage as W, will be



the largest. The magnitude of the current that can be delivered by this apparatus is generally small, and is limited by the size of the condensers. The method of connection forms the subject of German Patent No. 310,356 of the Siemens-Schuckert Works.

Mechanical rectifying commutators, or other types of electric valves, may be substituted for the hot-kathode valves. Overloading above the saturation current of the valves is impossible, and when out of use repairs may be effected without danger of shocks, which is one of the advantages as compared to a battery of cells.—*Tech. Sup. to the Review of the Foreign Press.*

Electrical Engineers in Holland.—Kon. Instituut van Ingenieurs, last week, entertained at the Hague a party of representatives of the Institution of Electrical Engineers. The party comprised Mr. C. H. Wordingham, Mr. L. Atkinson, Mr. G. Balfour, Sir Thomas Callender, Mr. B. Drake, Mr. W. W. Lackie, Mr. C. P. Sparks, Mr. W. B. Woodhouse, Mr. P. F. Rowell, Mr. G. H. Parr, and Prof. Marchant, of Liverpool. The visitors were to be received by the Queen of Holland, on Friday last, at Het Loo Palace. Visits were also to be paid to the State coal mines in Southern Limburg, to Arnhem, and Groningen, and the tour was to conclude on Sunday with a sail on some of the Frisian lakes.

Appointments Vacant.—Cable jointers for the Liverpool City Council; workshop instructor in electrical engineering (£160 + £100) for the City and Guilds Engineering College, South Kensington; charge shift engineer (£250 + 20 per cent. + £90) for the L.C.C. tramway generating station; assistant engineer (£350) for the Gravesend borough electricity works; sub-station engineers, power-house superintendents, ice-plant superintendents, supervising electricians, water-works superintendents, millwright engineers, electrical workshop superintendent, for the War Office stations in Mesopotamia. See our advertisement pages to-day.

Institution and Lecture Notes.—Diesel Engine Users' Association.—At the next meeting of the Association, the subject of the life of connecting-rod bolts and their periodical renewal, as well as the general question of heat treatment, is to be further discussed. Information is also to be given as to the proposed Research Association under the Government scheme for the purpose of carrying out research work on liquid fuels for use in Diesel and semi-Diesel engines.

The dinner of the Association is to be held on October 23rd.

Association of Mining Electrical Engineers.—The meetings of the London Branch of the Association have been resumed, after a lapse of several years owing to the war. Visitors are invited to the next meeting, to be held at Kingsway Chambers (top floor), 46, Kingsway, at 6.30 p.m., October 22nd; an attractive programme has been arranged, which will interest all identified with electricity as applied to mines. It is hoped that all London members who can arrange it will attend the general meeting at Edinburgh on October 10th and 11th, when the Lord Provost has invited all members of the Association to a civic reception on the Saturday afternoon. Full particulars of the objects and procedure of the Association can be obtained from the Secretary of the London Branch, Mr. F. V. Turquand, 73, Albion House, W.C. 1.

Electro-Harmonic Society.—The first smoking concert of the 1919-1920 Season will be held at the Holborn Restaurant (Venetian Chamber) on Friday, October 10th, commencing at 8 p.m. The other arrangements for the session are as follows:—

November 21st (Friday).—Ladies' night.
December 12th (Friday).—Smoking concert.
January 9th, 1920 (Friday).—Smoking concert.
February 13th, 1920 (Friday).—Ladies' night.
March 19th, 1920 (Friday).—Smoking concert.

There is every reason for looking forward to a record season.

Commercial Agents in Latin-America.—The white population of Central America and parts of South America is but a small minority, and yet it is generally in control of the greatest business organisations. It maintains habits of grace which are more or less traditional. It is demanded, for instance, as an index of good breeding, that everyone speak French with reasonable fluency. A certain familiarity with *belles lettres* and at least with classic art is expected. More or less ancient conventions are kept up. The obligation of good manners becomes a family tradition. They have what actors call "the grand manner."

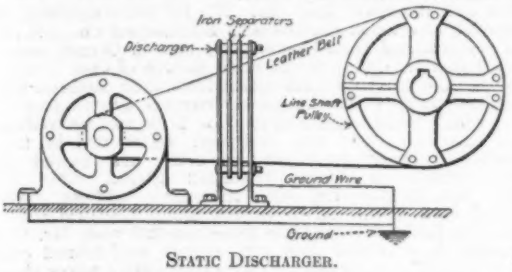
Now, many of our technical schools are so intensely practical that graduates often are not even on terms of amity with their own mother tongue, and those studies known as the humanities are passed by as useless. Modern languages also are neglected.

The position of the South American person of circumstance, when a man from North America visits him, is that he would like to "get a line on him," as we say; to find out what sort of person he is. He may or may not know the name of the firm represented; the chances are, at all events, that he knows very little about it. The man who calls is his point of contact. If the latter makes a disagreeable impression he does not want any dealings with him. His business relations he also considers as social affiliations—which often confuses the man from the north. Agreeable persons from abroad are scarce, and they are greatly desired. He wants to deal with somebody who can understand him and his ways, including his likes and dislikes. Things that are negligible to the North American buyer become of leading importance to buyers from South America. Dates of shipment, metric units in packages, the size and shape of single packages, and many other details present themselves as more important even than the price to be paid—within reasonable limitations. There are a thousand reasons why his unbidden visitor should be to him what he terms *simpatica*.

Again, if anything is thrown at a South American buyer with the statement that he can take it or leave it alone, the chances are preponderant that he will leave it alone. If the visitor lacks the time, or the inclination, or the wit, or the understanding to engage in a couple of hours of conversation, the host is unlikely to be interested in anything he has to say. He will be interested, however, the following week if a competitor who knows how to talk to him comes around. He is not ready to discuss business until he has had a chance to size up his visitor.

For the man who goes to South America to do business, a term at a commercial high school and a course in engineering are not enough. What he needs is polish, *savoir faire*, versatility, and at least the semblance of grace. Then he can gain the friendship of the real men of substance, and get their trade as well.—*Chem. and Met. Engineering.*

Static Electricity.—In the manufacture of bronze and aluminium powder, the air is a dense fog of suspended metal dust, which penetrates anything and everything. The air becoming dry, especially in some seasons, produces a large amount of static electricity on large leather belts, and in order to prevent serious trouble it is necessary to take every precaution to prevent the production of static electricity. The production of aluminium powder is always more or less attended by the risk of explosions, the consequences of which may be readily imagined if a spark were to ignite the powder. In the plant with which the writer has been connected, 50 H.P., three-phase, 60-cycle, squirrel-cage motors driving line shafting through leather belts were housed in separate rooms kept as dust-tight as possible. It was noticed that a large amount of static electricity was being produced which at times was so strong that it was unpleasant to approach within 3 ft. of the belt. After two weeks' constant running, the first of the motors put to work broke down, apparently earthed. Just prior to the breakdown small explosions occurred in the motor, emanating from the bottom portion of the air gap, the cause of which was put down to static charges from the belt. In order to prevent this a discharger was made and placed as shown in the figure. It was made as follows: Four pieces of ¼-in. by 1-in. iron were made up to form a grid, the two



Static Discharger.

outside pieces being long enough to reach the floor to which they were secured, and the two inside pieces long enough to span across the belt as near the motor pulley as convenient. The four pieces were separated 1¼ in. by pieces of ¾-in. iron pipe. The discharger was earthed independently and placed as near the motor as possible. This device, by bridging both sides of the belt, makes it impossible for static electricity to be produced, and is a distinct advantage over makeshifts.

After the installation of this device, motors which had been continually breaking down ran for a period of 18 months before another breakdown occurred, which from symptoms observed just prior to the complete failure, was attributed to static phenomena in the motor itself. After the motor had been removed to the repair shop, tests were made with a 1-in. spark induction coil which easily discharged through the punctured insulation of the stator winding. The star connection was opened, and the test applied to each coil until the three faulty ones were located, which when removed from the slot plainly revealed the punctures through which the winding was eventually earthed, and of course broke down. On rewinding the stator a corona leaf consisting of tin foil was inserted in each coil, and the whole earthed to a wire ring fastened at intervals to the stator frame. The use of the corona leaf effectively prevents static charges being produced in the motor itself. It is questionable if totally enclosed machines would be immune from the same trouble unless fitted with the corona leaf.—*American Machinist.*

Railway Strike.—A national railway strike, resulting in the stoppage of all steam and electric railways, began at midnight on the 26th ult. following the breakdown of negotiations between the Government and the National Union of Railwaymen. The strike concerns the rate of wages to come into force at the New Year. The men demand standardisation so that men doing the same kind of work for different companies in one town shall not, as now, receive different rates of pay. But they demand the standard rate shall in all cases be what is now the highest. This principle has been conceded by the Government for the locomotive men. But for goods and permanent way men it offered double pre-war pay with a 40s. a week minimum. This, the National Union says, means in some cases a reduction of from 11s. to 14s. a week. The men at the electrical power station at Lots Road, Chelsea, which supplies the tubes and the Surrey tramways, ceased work in sympathy with the N.U.R. (to which half the workers at the power station belong) at midnight on Friday, thus bringing to a standstill all the Surrey services of the L.U.T., which rely on this station for power. The secretary of the Electrical Trades Union told a Press representative that his committee would meet to consider taking action in support of the railwaymen. At the Lots Road power-house only a sufficient number of men reported for duty on Saturday morning to enable the pumping machinery to be worked to keep the underground and tube railways clear of water. The same applies to the Wood Lane power-house. The Transport Workers' Federation met on Monday, and the Vehicle Workers' Union discussed the position of the tramway and omnibus employés. On Monday the railway companies stated that a considerable number of men were reporting for duty. With the aid of loyal trade union drivers and enrolled volunteers practically all the railway companies were running restricted, including long-distance, services. At midnight on Sunday the Lots Road power-house was fully manned by volunteer workers, and electricity supply was available. The Surrey tramway services were, therefore, put in operation again on Monday morning. With volunteer help experimental services were being run on the District Railway and the Hampstead Tube to familiarise the volunteer workers with the lines, and it was hoped that later in the day a partial service might be run between Hammersmith and the Mansion House and between Hampstead and Charing Cross. An electric train service between Waterloo and Hampton Court was run all day. A 20-minute electric service was also run between Victoria and the Crystal Palace. The Metropolitan Railway was the only line to maintain a regular service over the week-end; both on Saturday and Sunday a 20-minute electric service was maintained between Baker Street and Harrow. On Tuesday it was officially announced that the train service was growing steadily, both in London and the provinces. Some minor acts of sabotage have been reported. Fortunately no loss of life occurred; the necessary steps were taken. At Battersea on Monday night an attempt was made to wreck a train by changing signal lights; the vacuum-brake connection of a train at Manchester was cut, and at Glasgow the railway points were blocked. Loyal locomotive drivers and volunteer transport workers have been attacked in Scotland, Cambridge and London. Attacks have also been made on a number of trains, signal cabins, and loyal workers in Scotland.

The District Railway was reopened between Hammersmith and the Mansion House, and the Tube between Golder's Green, Hampstead and Charing Cross on Tuesday morning. The L.B. & S.C. Railway hoped to maintain an all-day service of electric trains between Victoria and Balham. The Central London Tube hoped to open before midday on Wednesday. The Government called for volunteers for various duties, including telegraph repairers and wireless operators who had experience in the Army or Air Force and who were willing to render continuous service where required in the event of an emergency arising, and large numbers responded. It was also requested that the telephone, telegraph, and other postal services should not be used more than was absolutely necessary.

The following are the cases of the Government and railwaymen respectively:—The pre-war wages of 100,000 of the lowest grade were 18s. and 20s.; the war wage (33s.) brought these up to 51s. and 53s. The men claimed at the end of last year that their then wages should be made permanent; this the Government refused, but agreed that wages should remain at the armistice figures till December 31st next, when war wage was to be revised in the light of the cost of living, which might be then lower. But no reduction was to be made on present earnings until three months after the cost of living had decreased by 5 per cent.; the present war wage was to remain for at least six months from now. In any case, double the pre-war rates with a 40s. minimum were guaranteed, even if the cost of living fell to pre-war level. The Government promised special consideration for harsh cases or anomalies.

The railwaymen want to remove the unfairness of one man in one grade receiving one rate of pay and another man in the same grade receiving a different rate. This was granted in August so far as drivers and firemen were concerned; their wages were standardised on the highest basic rate, more than doubling the pre-war pay in some cases. The railwaymen want the same principle adopted for all grades, but guards and signalmen whose wage was considerably higher than the enginemen's before the war have not been offered the same percentage of advance; they want a £3 minimum. The lower-grade men are offered, it is stated, a permanent wage lower than they are now receiving.

Industrial League and Council.—The first of the fourth series of lectures on Industrial Problems, arranged by this body, takes place at the Guildhall, at 4.30 p.m., on Tuesday, October 7th, when the Right Hon. G. H. Roberts, M.P. (Food Controller), will give an address on "Some Trade and Labour Problems." Application for tickets should be made to the Secretary, Industrial League and Council, 66, Victoria Street, S.W. 1. 'Phone: Vic., 6449.

Water Japan.—Baking japan, as ordinarily used in the industry, consists of a "base" and "solvent." The base contains one or more of the various asphalts together with some such oil as linseed or china-wood oil. The solvents in common use are naphtha, kerosene, and similar products, which create considerable fire risk, especially in the baking oven, and it was to eliminate this risk that "water japan" was developed. Water japan consists of an emulsion of japan base in water. While it is less viscous than ordinary japan, methods have been devised for applying it so that the deposit is practically free of solvent. The electric-dip method is adapted to small odd jobs of japanning rather than to quantity production. The water japan is put in an iron tank which is connected to the negative terminal of a D.C. circuit. The metal to be coated is connected to the positive side of the circuit. The thickness of deposit obtained depends upon the product of the current density and the time. The current at 125 volts will average about 0·8 amp. per sq. in. of surface to be covered. The hot-dip method is adapted to work with large quantities of castings, punchings, &c. The metal is placed in a wire basket, heated in an oven temperature of about 500° F. It is then cooled to about 400° F., and quickly plunged into cold-water japan. These methods are fully described in the *General Electric Review*, August, 1919.

Electric Bakery Ovens.—Owing to fuel shortage, considerable attention is being given to electric heating for all purposes in Switzerland, and in an article in the July 26th *Bulletin de l'Association Suisse des Electriciens*, the author attempts to show the saving in fuel effected by using electrically-heated ovens for bakeries. It is calculated that at present some 110,000 tons of coal are consumed in bread-baking, and when the restrictions on the baking of confectionery are removed, this may be increased to 200,000 tons per annum. An ordinary type of electric oven used is in brickwork, so as to maintain a high thermal capacity; it is of the single-shelf type, having up to 6 m² of baking surface. Some of the large bakeries use ovens having 12 sq. m. of baking area. In the latter it is possible to bake from 16 to 18 kg. of bread per sq. m. of oven. The time of baking is from 1 hour to 1 hour 12 minutes for loaves of 500 gr. to 1 kg., and from 1·25 to 1·5 hours for loaves of 1·5 to 2 kg. The heat capacity of these large ovens is considerable. After the oven is raised to the baking temperature (250° to 300° C.), the current may be cut down, and one to two batches baked, which takes 3 to 4 hours. The power consumed is about 6 KW. per sq. m. of oven, and the oven is brought to baking temperature in 1·5 hours. During baking, the power necessary for maintaining the temperature at the desired value is from 40 to 50 per cent. lower. The expenditure of energy per kilogram of bread is proportionately low the greater the number of batches. To raise a 12-m. oven to the temperature required, the energy consumption is 1·5 × 12 × 6 = 108 KW.-hours. In an oven of these dimensions it is possible to bake 200 kg. of bread per batch, and the time of preparation and baking is 1 to 2 hours, or a mean, say, of 1·75 hours per batch, and the expenditure of energy works out at 1·75 × 12 × ⅝ = 63 KW.-hours. For a single batch the energy consumption per kilogram of bread is :—(108 + 63)/200 = 0·85 KW.-hour (or, say, 0·4 KW.-hour per lb.). With three batches : (108 + 3 × 63)/600 = 0·50 KW.-hour (or, say, 0·22 KW.-hour per lb.) ; and for six batches : (108 + 6 × 63)/1,200 = 0·41 KW.-hour (or, say, 0·186 KW.-hour per lb.). The writer then discusses the quantities of heat necessary for baking a kilogram of bread, and shows that electric ovens are superior to coal-fired types. It must be remembered that these statements are based on the present price of coal in Switzerland, and on prices of energy ranging from 2 to 6 centimes per unit. Electric heating is being installed in a large number of bakery furnaces in Switzerland. Messrs. Brown-Boveri and Co. have patented a system for fitting heating resistances to an ordinary oven without necessitating any stoppage of work. These resistances are made for pressures up to 500 volts, A.C. or D.C.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station and Tramway Officials.—Hammersmith Electricity Department recommends the Council to adopt the formula proposed by the Associated Municipal Engineers in regard to the remuneration of Mr. BELL, the chief electrical engineer, as from October 1st, 1919. His present salary is £800, plus war bonus £160, total £960. The salary under the formula works out at approximately £1,200 per annum. The Electricity Committee has appointed Mr. C. H. PADGETT, late of the Council's Public Health Department, to be consumers' clerk. There were 69 applicants. Mr. E. F. BEHENNA, late of the Hampstead B.C. electricity undertaking, has been appointed correspondence clerk.

Inspector C. NORCOMBE, M.M., who is leaving the Exeter Corporation tramway staff, after 13¼ years' service, has been presented by his colleagues with a wallet of Treasury notes.

The Cardiff Corporation has appointed a small sub-committee to consider the question of appointing a successor to Mr ARTHUR ELLIS, who has resigned his position as electrical engineer for the city in order to start a private practice. Mr. Ellis has consented to retain his present position until the end of the year.

Inspector H. HARRISON, Ashton-under-Lyne Corporation, on leaving to take up the position of assistant traffic superintendent of the Sunderland Corporation tramways, has been presented with a clock by his colleagues.

General.—On September 26th the executive and management of the Edison Swan Electric Co., Ltd., Ponders End, gave a hearty send-off to Mr. G. L. JUST, manager of the firm's Melbourne Branch, on the eve of his departure for Australia, after a two months' visit to this country. Mr. Just was the guest of honour at a dinner held at the Abercorn Rooms, Liverpool Street Station Hotel, Mr. J. W. Elliott (joint sales manager) presiding. There were present, Messrs. T. S. Read, C. A. Smith, E. H. Miller, A. F. Caine, F. Charles Raphael, J. Cooper, John R. Sells, G. W. Tuffill, H. J. Evans, W. F. Ingamells, C. Cummins Cherry, and L. Rabinovitch. After the toast of the King had been honoured, the health of Mr. Just was drunk, and Mr. Child, on behalf of his colleagues, presented Mr. Just with a gold cigarette case suitably inscribed.

Mr. HERBERT BROADBENT, M.I.E.E., who resigned his post as electrical engineer to the Corporation of Perth, W. Australia, in 1915, in order to take part in the war, and was appointed chief engineer to the Government projectile factory at Cardonald, near Glasgow, sailed on Sunday last for Perth, W.A., where he will start in business on his own account.

The marriage took place on September 10th, at Hawick, of Mr. ERNEST B. BARTON, A.M.I.E.E., manager for the Urban E.S. Co., Ltd., at Berwick-on-Tweed, and formerly manager of the firm's works at Hawick, and Miss Isabel Mary Wilson, younger daughter of Mr. J. B. Wilson, of Balgrun, Hawick.

Sapper G. E. MOORE is now demobilised, after three years in the Army. He joined up in the M.T., A.S.C.; later was transferred to and went to France with the R.W.F.; after six months' overseas service, joined the Experimental Sound Ranging Section, R.E., and remained in it until released last week. He hopes to be identified with electro-technical research work.

Mr. P. F. BRITTAIN, of Brittain's Electric Motor Co., London, has joined the board of the Automobile Aircraft and Engineering Insurance Co., Ltd., affiliated with the General Accident, Fire & Life Assurance Corporation, Ltd.

Mr. A. E. DAWSON, late district manager of the General Electric Co., Nottingham branch, has resigned his position and started in business as The Dawson Electric Co., St. Peter's Church Walk, Nottingham (wholesale only). Manufacturers are asked to forward catalogues.

We are informed that Mr. W. D. SHIREHAMPTON, the managing director of the Overseas Engineering Co., Ltd., has recently returned from an extensive tour in Canada and the United States. Owing to the rapid growth of their American business, the company have consolidated their interests there, and have formed the American Overseas Engineering Co., Inc., which whilst registered in New York will be controlled from London. The new company, which will in future handle all their American business, has moved into larger offices at 44-45, Whitehall Street, New York City, but retains the old telegraphic address "Overthere," New York. After visiting many electrical and engineering factories during the three months' visit, Mr. Shirehampton is convinced that with certain well-defined exceptions, Britain is quite able to quote competitive prices abroad, especially in the larger details of electrical equipment, and that as soon as deliveries for export from Great Britain are more normal, American electrical exports will show very marked decrease. Mr. Shirehampton thinks that American labour conditions are likely to prove much more difficult during the next few months, and that manufacturing costs over there are likely to increase still further, which should help this country to regain some of its export trade.

Captain A. H. LAW has resigned the position of managing director of Messrs. C. A. Parsons & Co., Ltd.

Mr. WRIGHT BROADBENT, the telegraph superintendent at Huddersfield, on September 26th, completed 47 years' service in the Post Office and went into retirement.

NEW COMPANIES REGISTERED.

J. W. Kitson & Co., Ltd. (159,073).—Private company. Registered September 24th. Capital, £17,500 in 16,600 10 per cent. preference shares of £1 each and 50,000 ordinary shares of 1s. each. To take over the business of J. W. Kitson & Co. (established in 1883) of boiler and steam pipe coverers and manufacturers of Kitson's Eureka non-conducting compositions carried on at Blackwall, and to enter into an agreement with W. M. Ellis. The subscribers (each with one share) are: C. W. Daive, 19, Brunswick Street, Blackwall, E.14, manager; S. J. Culson, 19, Brunswick Street, Blackwall, E.14, engineer. The first directors are: W. M. Ellis and Mrs. P. Ellis, both of 4, Sylvan Road, Upper Norwood, S.W. Qualification, £100. Secretary: C. Fairbairn. Registered office: 21, Brunswick Street, Blackwall, Poplar, E.

Newcastle Engineering Co., Ltd. (159,077).—Private company. Registered September 24th. Capital, £25,000 in £1 shares. Objects: To take over the business of engineers and machinery merchants carried on at Tyne Dock Entrance, Corsterphine Town, South Shields, as "Reed and Foggin," and to carry on the business of manufacturers and repairers of internal combustion and other engines and electrical and other motors, &c. The subscribers (each with one share) are: W. T. M. Foggin, Bilton, Lesbury, engineer; J. C. Gunn, Willows, Morpeth, naval architect. The first directors are: J. C. Gunn, W. T. H. Foggin, S. Gunn, W. R. Potter and J. H. Reed and one other to be nominated by the said J. C. Gunn. Solicitor: J. E. Gibson, 7, Grey Street, Newcastle-on-Tyne.

Banbridge Gas and Electricity Co., Ltd. (4,783).—Private company. Registered in Dublin, September 16th. Capital, £10,000 in £1 shares. To acquire the business of the Banbridge Gas Co. The subscribers (each with one share) are: J. U. Finney, Newry Street, Banbridge, merchant; M. Curran, 2, Kent Street, Belfast, engineer. J. U. Finney is governing director. Registered office: Reilly Street, Banbridge.

Vickers-Australia, Ltd. (159,053).—Private company. Registered September 23rd. Capital, £10,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in steel, iron, brass and metals, shipbuilders, shipwrights, armament manufacturers, electricians, &c. The subscribers (each with one share) are: T. J. Abbott, 147, North View Road, N.8, clerk; W. C. Flynn, 6, Bulmer Terrace, Notting Hill Gate, W., clerk. The first directors are to be appointed by the subscribers. Registered office: Vickers House, Broadway, Westminster, S.W.

Midland Metallurgical, Ltd. (159,042).—Private company. Registered September 23rd. Capital, £1,000 in £1 shares. Objects: To carry on the business of manufacturers, importers and exporters of and dealers in ferrous and non-ferrous metals, ores, alloys, chemicals, paints, colours and varnishes, oils, greases, laboratory and electrical apparatus, electrical furnaces for manufacture and treatment of all metals, electrical and mechanical equipment of works and factories, &c. The subscribers (each with one share) are: D. G. Page, Norfolk House, 36, Cannon Street, Birmingham, engineer; W. S. Woolley, 111, Queen Street, Sheffield, manufacturer. First directors: D. G. Page and W. C. Woolley. Qualification, 50 shares. Registered office: Norfolk House, 36, Cannon Street, Birmingham.

Tredelect Dynamos, Ltd. (158,986).—Private company. Registered September 20th. Capital, £60,000 in £1 shares (15,000 7 per cent. cumulative participating preference). To take over the English patent rights for the Tredelect Car Lighting Dynamos and Cut-outs, with the English business of the Tredelect Engineering Co., Ltd., &c. The subscribers are: H. C. H. Smyth, 28, Alwyn Avenue, Chiswick, W.4, engineer, 1 ordinary share; G. F. A. Norman, 86, Twyford Avenue, Ealing, W.5, engineer, 1 preference share. The first directors are: H. A. Bartlett, H. C. H. Smyth and G. F. A. Norman. H. A. Bartlett may retain office while holding 1,000 shares. Solicitors: Munns and Longden, 4b, Fredericks Place, Old Jewry, E.C.2.

Kelvindale Electric Manufacturing Co., Ltd. (10,639).—Private company. Registered in Edinburgh, September 22nd. Capital, £5,000 in £1 shares. To carry on the business of electrical, mechanical, consulting and contracting engineers, &c., and to adopt an agreement between A. A. Schaschke, M.A.M.E.E., of the one part, and W. R. C. Murdoch of the other part. The subscribers (each with one share) are: G. S. Sharp, 4, Watson Street, Glasgow, merchant; W. R. C. Murdoch, 98, West George Street, Glasgow, solicitor. The first directors are not named. Solicitor: W. R. C. Murdoch, 98, West George Street, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Apparatus Co., Ltd. (London).—Mortgage on freehold property at St. Albans, dated July 30th, 1919, to secure all moneys due or to become due from company to L.J.C. and Midland Bank.

London United Tramways, Ltd.—Assignment on August 8th, 1919, of £230,000, payable under an agreement with the L.C.C., to secure £200,000. Holders: L.C.W. and Parr's Bank.

Mead & Jeffery, Ltd.—Debenture dated July 23rd, 1919, to secure £500, charged on the company's general assets. Holder: W. Bromley, 82, Uxbridge Road, Ealing.

Hong-Kong Tramway Co., Ltd.—Equitable charge on land outside the U.K. dated May 31st, 1919, to secure 700,000 dollars. Holders: Hong-Kong and Shanghai Banking Corporation, Ltd.

CITY NOTES.

Southern Brazil Electric Co., Ltd.

Mr. E. H. Tootal, presiding at the annual meeting, held in London on September 25th, said that in addition to the general difficulties affecting all countries in a more or less degree, the State of Sao Paulo, in which their interests mainly lay, had had to contend with special troubles of its own. The damage caused to the coffee trees by the unprecedentedly severe frosts proved to be quite as severe as the worst accounts predicted. The second serious trouble was the outbreak in October last year of a most violent epidemic of influenza, which for some weeks materially impeded the working of most of the public services and the industrial enterprises in the State. The epidemic was now a thing of the past, but during its acute period it necessarily entailed a loss of revenue and an increase of expenditure in various directions. They would therefore not have been surprised to see that the result of the operations for the financial year was a loss of £6,954, which reduced their carry forward in profit and loss account to £2,154. Everything now justified the belief that they were about to enter upon a much more satisfactory state of affairs. Their big construction work had now been practically completed, what remained to be done being the normal extension of lighting and power supply, for which there was a steady demand, owing to the general prosperity prevailing in the district. Revenue had increased progressively since the beginning of the year, and promised to develop further before its close, as new installations got into fuller working. Brazil, in common with the rest of the world, had for some time past been indulging in the expensive luxury of strikes, though the Brazilian authorities as a rule had shown commendable energy in curbing the excesses of strikers. The workmen of the Companhia Campineira went on strike some months ago, not because they had any complaint to make, as they themselves admitted, but because they were intimidated by other men on strike into joining them, and for one day the tramway cars had to be run under police protection. The dispute was promptly settled by Mr. Lowes in such a way that, while repeated strikes had since occurred in other quarters, their men had given no further trouble.

French Companies.

The accounts of the *Société Anonyme l'Appareillage Elsctrique, Grivolas*, show net profits of £30,000 for 1918-19, this result comparing with £29,000 in the previous year. At the recent meeting a dividend of 10 fr. per share was declared, being the same rate as in 1917-18.

The directors of the *Appareillages Electriques, Grammont, S.A.*, state that the net profits realised in 1918-19 amounted to £10,000, permitting of the distribution of a dividend at the rate of 6 per cent. on the paid-up capital, *plus* a bonus of 2.50 fr. per share. These combined represent 8.50 fr., as compared with 8 fr. in 1917-18.

The report of the *Electro-Métallurgique Francaise* (Froges), which was presented at the recent annual meeting held at Froges, states that the control of aluminium, which had been requisitioned since August, 1915, was released on November 27th, 1918. As a result, however, of the transfer of the war works to peace manufactures and the invisible stocks in the hands of customers on the cessation of hostilities, the demand for aluminium was practically null during the last two months of last year, and although it was now slowly rising it was still far behind the figures recorded before the war. After setting aside £48,000 for depreciation, the accounts show net profits of £112,000 for 1918, and a dividend at the rate of 6 per cent. has been declared on the fully-paid ordinary shares.

German Companies.

The Wolfram Lampen. A.G., of Augsburg, most of whose share capital is held by the German Incandescent Gas Light (Auer) Co., reports a loss of £13,000 for 1918-19, as compared with net profits of £5,000 in the previous year, when a dividend at the rate of 6 per cent. was declared.

The Deutsche Elektrizitats Werke, Garbs Lahmeyer & Co., of Aix-la-Chapelle, after setting aside £45,000 for depreciation in 1918-19, as against £39,000 in 1917-18, reports net profits of £42,000 and £72,000 in the two years respectively. A dividend of 6 per cent. has been approved, being the same rate as in 1917-18.

The Brandenburg Carbid und Elektrizitats Werke A.G., of Berlin, after placing £10,000 to the depreciation and renewal funds in 1918, as compared with £9,000 in the previous year, reports net profits of £16,000 and £15,000 in the two years respectively. It is proposed to pay a dividend of 7 per cent., as in 1917. The directors state that the Steinbuch carbide works suspended production in July, 1918.

The Isaria Zahler Werke A.G., of Munich, makers of meters and associated with the Brown-Boveri group, report gross profits of £205,000 for 1918-19, as compared with £151,000 in the preceding year. After meeting general expenses and allocating £6,000 to depreciation, as against £22,000 in 1917-18, the accounts show net profits and balance forward of £37,000, as contrasted with £35,000. The dividend is at the rate of 15 per cent., as in the previous year.

Prospectuses.

Ward & Goldstone, Ltd.—The registration of this company with a capital of £200,000 was announced in our last issue. It takes over a business which is thoroughly well known to all our readers everywhere, a business which, according to the evidences and reports that have reached us, has been handled with great enterprise, especially during the period of the war when the opportunities open to the firm for manufactures of the classes that they had long been producing, were both numerous and urgent. The directors are now making an offer to the public of 80,000 seven per cent. cumulative and participating preference shares of £1 each, for subscription at par. The list opened on Saturday last, and is announced to close on or before October 4th. The prospectus states that the company has been formed for the purpose of acquiring the business, established over 25 years, of Messrs. Ward & Goldstone, electrical engineers, of Sampson Works, St. Simon Street, Salford, near Manchester. Owing to the continued expansion of trade it has been found necessary to acquire larger works, and the vendors have entered into a contract to purchase the modern works situate in Pendleton, near Manchester, now occupied by the Churchill Machine Tool Co., Ltd., including certain plant and fixtures, for £38,000. The property acquired covers an area of over two acres, and is particularly suitable for the specialities manufactured by Messrs. Ward & Goldstone, and will allow of a very considerably increased production. Until possession of the new works is obtained the company will continue to carry on business at the Sampson Works and its extensions. The auditors of the company, Messrs. Murray, Burman & Co., chartered accountants (as to the years 1917 to 1919), and Mr. J. W. Beever, chartered accountant (as to years 1912 to 1916), show that the profits before deducting income-tax and excess profits duty and after writing off generous depreciation and the whole of the expenditure on advertising have been as follows:—

April, 1911, to March, 1912	£7,506
Year ending March, 1913	6,875
March, 1913, to April, 1914	6,913
April, 1914, to March, 1915	9,889
Year ending March, 1916	16,130
Year ending March, 1917	25,635
Year ending March, 1918	26,358
Year ending March, 1919	26,770

The profits during the last three years average over £26,000. On this basis a net sum will be available for dividends, after allowing for excess profits duty at 40 per cent. and directors' remuneration, and allowing only 5 per cent. per annum earning power on the additional net capital of £38,000 derived from this issue and from the accrued profit as stated below, of over £17,650. There should be a substantial surplus after payment of the above dividends of 7 per cent. available for further dividends on the preference and ordinary shares, reserves, &c. The purchase price for the sale of the said business has been fixed at £95,008, of which £32,000 represents the value of the goodwill, patents, trade marks, &c., the said sum of £95,008 to be paid or satisfied as to £40,000 in cash and as to £55,008 by the issue to the vendors of 55,008 fully-paid ordinary shares in the capital of the company.

South African Carbide and By-Products Co., Ltd.—This company has been formed by the Chemico Electric Co., Ltd., for the purpose of manufacturing calcium carbide and of extracting by-products from coal and shale, at Ballengeich Collieries, Natal, South Africa; it will also manufacture ammonium sulphate. Supplies of coal have been contracted for, and a site has been obtained with facilities for water supply. Other raw materials have also been arranged for. Technical

reports have been furnished by Messrs. Harper Bros. & Co. and Mr. C. W. Tozer, and Messrs. Charles Bingham & Co. have reported on the carbide scheme. The present issue is of 300,000 7 per cent. cumulative participating preference shares of £1 each and 150,000 ordinary shares of one shilling each, making a capital of £307,500. The list is to close to-day, October 3rd.

Potteries Electric Traction Co., Ltd.—According to the *Financial Times* it is announced that terms have been arrived at between the Potteries Electric Traction Co. and the Stoke-on-Trent Corporation for the purchase of the former's undertaking. The Council will acquire the system for £737,800. "This total includes interest at 5 per cent. on capital while the price is being paid off during the next 30 years in semi-annual instalments. . . . According to the method of payment, it would appear as if the company will have to be kept alive as an investment concern until the last of the purchase consideration has come to hand."

Shanghai Electric Construction Co., Ltd.—The directors announce an interim dividend of 6 per cent., less tax, for the past half-year.

Stock Exchange Notice.—Application has been made to the committee to allow the following to be officially quoted:—
Anglo-Portuguese Telephone Co., Ltd.—£50,000 5 per cent. extension debenture stock.

Calcutta Electric Supply Corporation, Ltd.—Units sold to consumers during the five weeks ended August 1st, 1919, 3,380,053, compared with 3,289,609 last year.

STOCKS AND SHARES.

TUESDAY EVENING.

In the Stock Exchange the main feature of the railway strike has been the remarkably calm way in which the markets accepted the situation. On Monday morning there was certainly a mild excitement, and some hot-heads went so far as to suggest that the House should be closed, on the ground of the difficulties incidental to payment for stock by men unable to get to their offices, or by clients who could not rely upon their cheques reaching London from the country. It was quickly decided, however, that to shut the Stock Exchange would be undesirable from most points of view.

This point settled, the markets got to work. Falls in most departments were recorded, but their range, while extensive in area, was small individually. Home Railways gave way to some extent, although there was no particular justification for this, as the dividends are practically guaranteed for another two years, or more, under the arrangements with the Government. Intimation that the District Railway would resume a limited service on Monday afternoon served to keep the electric railway stocks steady. Metropolitan Consolidated is even 10s. higher on the week. The "roaring trade" done by the motor-'buses was quoted as an additional reason for this firmness. Underground Electric income bonds shed a point, and the shilling shares weakened to 8s. 3d.

The market for electricity supply shares maintained its prices, although the tendency has been dullish. This is held to be due to two causes—one, the coal problem, intensified by the strike, and the renewed appeal to the public to use as little electricity and gas as possible. The second reason is the off-chance of the railway labour despots calling an all-round strike when they realise that the railway strike can be met by such emergency measures as counteract, at least partially, the benevolent and patriotic aim to bring the country to a standstill unless certain grades of railway workers are assured of the same rate of pay next January as they receive now. With the possibility of such a thing in the offing, and with nobody anxious to buy any kind of stocks and shares, the market has some excuse for heaviness. Kensington are marked down to 4¾. County of London preference lost ¼, the decline being balanced by a rise of equal amount in the ordinary.

Amongst the shares which suffered most from the prevailing conditions, Marconis are a fair example. The price had been run up from 5 3-16 to 5 13-16 on speculative buying, based on the idea that a big bonus is pending in the shape of a new issue of shares at par. Speculation "dried up," to quote the Stock Exchange colloquialism, in most securities, and buyers-for-the-quick-turn tried to cut a small loss. This brought back the price to 5⅛, which still leaves a gain of 3-16 on the week. Other members of the Marconi group gave way slightly. The preference drooped to 4¾. Canadian Marconis had been a feature of strength at the end of last week, when the price rose to 16s. 9d., but in the malaise it subsided to 16s., Americans to 31s. 9d., while Marines, after touching 3, rallied to 3 1-16.

In the manufacturing list, Siemens parted with some of their recent strength, declining to 25s. 6d. and recovering to 26s. 3d. The company's year ends on December 31st, and expectation looks for repetition of the usual 10 per cent. dividend. Rumour had been busy linking Siemens with the English Electric Co., and, on this, a little speculation took place in the shares of the former. As already noted, speculation stands at a wide discount just at present, except that kind which concerns itself with how a man can get to and from his ordinary work day by day.

Electric Constructions can be bought at the middle price of 22s. 6d. English Electrics have eased off to 24s. 6d. General Electric ordinary fell ¼ to 37s. 6d., and the preference declined to 19s. 4½d. Callender's are again ¼ down at 8¾. Metropolitan-Vickers preference, which are still called Westinghouse preference by the market, have gone back 1-16 to 3 5-16.

Amongst cable securities, Eastern Extensions have crept up very close to 16, while Western Telegraphs at 16¼ are 2s. 6d. down. Both the Globe shares are quoted ex dividend, and the yields become raised to five guineas (free of tax) on the ordinary and £5 18s. 5 per cent., less tax, on the preference. Great Northerns are 10s. up. Indo-Europeans fail to rally from their recent sharp drop.

Most of the Mexicans are in the doldrums, with more sellers than buyers. Anglo-Argentine Tramways second preference have dropped 5s. In the lower-priced list, Pernambuco ordinary gave way to 5s. 3d., and the preference to 13s. For the Canadian Utility Companies' bonds there has been rather more demand, on the movement of the American rate of exchange. Rio de Janeiro Tramways first mortgage bonds reverted to 89½ after having been better.

Rubber shares remain heavy in consequence of the sagging of the raw material. The Armament market is also dull, but the engineering group maintains its price. Babcock & Wilcox at 3½ are unchanged on the week. Stock Exchange business is very quiet, and the railway strike has switched off public interest from stocks and shares for the time being.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Sep. 30, 1919.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES					
Brompton Ordinary	10	8	6	—	£6 13 4
Charing Cross Ordinary	4	4	2⅞	—	7 5 6
do. do. do. 4½ Pref.	4½	4½	3	—	7 10 0
Chelsea	3	3	3	—	5 0 0
City of London	3	3	11½	—	6 19 2
do. do. 6 per cent. Pref.	6	6	9½	—	6 8 0
County of London	7	7	9⅝	+ ⅛	7 9 5
do. do. 6 per cent. Pref.	6	6	9½	— ⅛	6 11 9
Kensington Ordinary	7	6	4¾	— ¼	6 6 4
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	6	6	8½	—	6 11 6
Metropolitan	4	5	3	—	8 6 8
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 1 3
St. James' and Pall Mall	9	10	6¾	—	8 5 4
South London	5	5	2½	—	7 8 6
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5	—	8 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	5	6	96	—	6 5 0
do. Def.	1½	35/6	22½	—	7 9 0
Chile Telephone	8	8	6⅝	—	5 18 6
Cuba Sub. Ord.	7	7	10½	—	*6 13 4
Eastern Extension	8	8	15½	+ ½	*5 0 10
Eastern Tel. Ord.	8	8	159½	—	*5 0 4
Globe Tel. and T. Ord.	7	8	15½xd	—	*5 5 0
do. do. Pref.	6	6	10½xd	—	5 18 5
Great Northern Tel.	22	22	29	+ ½	7 11 9
Indo-European	13	13	4½	—	6 16 10
Marconi	20	25	5⅜	+ 3/16	4 13 0
Oriental Telephone Ord.	15	10	2⅜	— 3/16	4 11 9
United R. Plate Tel.	8	8	7⅝	—	*5 1 7
West India and Panama	1/3	1/3	1/6	—	*4 15 8
Western Telegraph	8	8	16½	— ½	*4 18 6
HOME RAILS.					
Central London Ord. Assented	4	4	60½	—	6 12 1
Metropolitan	1	1½	34½	+ ½	5 2 0
do. District	Nil	Nil	21⅛	—	Nil
Underground Electric Ordinary	Nil	Nil	8	—	Nil
do. do. "A"	Nil	Nil	8/3	—3d.	Nil
do. do. Income	4	5	92½xd	—1	*5 8 0
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4½	—	6 13 4
Anglo-Arg. Trams. First Pref.	5½	Nil	3	—	—
do. do. 2nd Pref.	—	—	2½	— ¼	—
do. do. 5 Deb.	5	5	64½	—	7 15 6
Brazil Tractions	—	—	58	—	—
Bombay Electric Pref.	6	6	12½	—	4 18 0
British Columbia Elec. Ry. Pfce.	5	5	66⅜	+1	*7 17 0
do. do. Preferred	Nil	2½	4⅝	—	5 7 6
do. do. Deferred	Nil	Nil	39½	—	Nil
do. do. Deb.	4½	4½	64½	—	7 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	50	—5	Nil
do. 6 per cent. Bonds	Nil	Nil	42½	—3	Nil
Mexican Light Common	Nil	Nil	30½	—	Nil
do. Pref.	Nil	Nil	48⅝	—	Nil
do. 1st Bonds	Nil	Nil	60½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3½	—	*4 5 9
British Aluminium Ord.	10	10	1 1/16xd	—	5 18 4
British Insulated Ord.	25	12½	2⅝	— 1/16	5 19 4
Callenders	25	25	8¾	—	7 2 10
do. 6½ Pref.	5	6½	5⅜	— ⅛	6 6 10
Castner-Kellner	25	20	2⅞	—	8 0 0
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	—	1½	—	6 0 0
do. do. 5 per cent. Deb.	4	5	81½	—	6 2 9
Electric Construction	10	10	1⅛	—	8 18 0
Gen. Elec. Pref.	6	6½	3⅜	— 1/16	6 14 0
do. Ord.	10	10	1⅛	— ⅛	*5 6 8
Henley	25	25	2⅞	—	8 8 0
do. 4½ Pref.	4½	4½	3⅜	—	6 4 9
India-Rubber	10	10	17	—	*6 17 6
Met.-Vickers Pref.	—	—	8⅛	— 1/16	4 16 8
Siemens Ord.	—	10	3 1/16	—1/16	*5 13 4
Telegraph Cos	—	30	36	—	*4 13 9

* Dividends paid free of Income Tax.

THE BRITISH ASSOCIATION.—IV.

A Trigger Relay operated by Thermionic Valves.

By W. H. Eccles and F. W. Jordan. (*Abstract.*)

Section G.—Engineering.

In a well-known method of using a triode for the amplification of wireless signals an inductive coil is placed in the filament-to-anode circuit and another coil magnetically coupled with this is introduced into the filament-to-grid circuit. This "back-coupling," if arranged in the right sense, greatly exalts the magnification produced by the tube in any alternating E.M.F. applied to the grid; for the induced E.M.F. passed back to the grid is in correct phase relation to add directly to the orignal alternating E.M.F. applied there. If instead of using inductive retroaction of this kind we attempt to use resistance back-coupling, then the retroactive E.M.F. applied to the grid is exactly opposite in phase to the original alternating E.M.F., and the amplifying action of the triode is reduced. Since, however, one triode can produce opposition in phase in the manner indicated, two or any even number of similar triode-circuits arranged in cascade can produce agreement in phase. Hence retroactive amplification can be obtained by effecting a back-coupling to the first grid from the second, fourth, and so on, anode circuit of a set of triodes arranged in an ohmically-coupled cascade.

It is possible to take advantage of the fact above stated for obtaining various types of continuously-acting relay, but the purpose of this article is to describe what may be called a one-stroke relay which, when operated by a small triggering electrical impulse, undergoes great changes in regard to its electrical equilibrium and then remains in the new condition until reset.

In what follows, the circuit comprising the space in the tube between anode and filament, the external conductors and the source of E.M.F., will be called the anode circuit, and the current flowing in it the anode current. The circuit comprising the space in the tube between the grid and the filament, external conductors, and a source of E.M.F., will be called the grid circuit, and the current flowing in it the grid current.

The operation of the relay is most easily explained when two tubes, each with resistance and battery in its plate circuit and with a resistance and battery in its grid circuit, are used and interconnected in the manner shown in fig. 1.

The electrical stimulus from outside which it is desired to detect and magnify is applied to the grid circuit in the first tube so as to make the grid transiently more positive in potential relative to the filament. This causes an increase of current in the plate circuit of the first tube, and con-

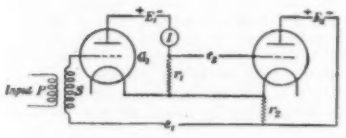


Fig. 1.

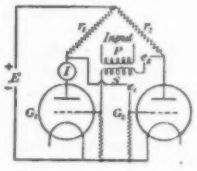


Fig. 2.

(Filament Batteries not shown.)

sequently an increase of the P.D. between the terminals of the plate circuit resistance. This increased P.D. is transferred to the grid circuit of the second tube in such a manner that the grid becomes more negative than before relative to its filament. Consequently the plate current of the second tube decreases, and the P.D. between the terminals of its plate circuit resistance decreases also. This decrease of P.D. is now transferred to the grid circuit of the first tube in such a manner that it tends to make the grid more positive relative to the filament. The result of these processes is that a positive stimulus from outside given to the grid of the first tube initiates a chain of changes which results finally in the plate current of the first tube attaining the highest value possible under the E.M.F. of its battery and the plate current of the second tube falling to its lowest possible value. This condition, therefore, persists after the disappearance of the initial stimulus. In the initial condition with the two-tube arrangement just described, the plate current of the first tube is made very small and that of the second tube large; after the reception of the outside stimulus on the grid of the first tube the final condition is a large plate current in the first tube and a small plate current in the second tube. Either the decreases or the increases of plate current can be used for indicating. In order to restore the initial conditions it is easy to interrupt for an instant the linkage between the tubes, or to stop the operation of one or both of the tubes, as, for instance, by dimming its filament.

The external stimulus is led into the primary P of transformer PS, of which the secondary is connected to grid G_1. The plate circuit of this first tube contains the indicating instrument I, such as an ammeter or a moving tongue relay. The resistance r_1 in the plate circuit of the first tube has its terminals connected to the filament and grid of the second tube. Similarly, the resistance r_2 in the plate circuit of the second tube has its terminals connected to the filament and the grid of the first tube. The plate circuits contain batteries E_1, E_2, and the grid circuits batteries e_1, e_2. The following values are typical and show the performance of the relay:—$E_1=78$ volts; $r_1=22{,}000$ ohms; $s_1=31$ volts; $E_2=74$ volts; $r_2=12{,}000$ ohms; $e_2=17.5$ volts. The change in the indication of an ammeter at I is from 0—2.5 microamperes.

The sensitiveness of the arrangement depends on the transformer PS to some extent. Using a telephone transformer of the kind made for Army C Mk. III amplifier with 20 ohms resistance in the primary and with the primary connected to a Brown telephone of 60 ohms resistance, the relay is operated with certainty by snapping the thumb and finger at a distance of 5 ft. from the telephone.

Fig. 2 shows another mode of interconnection of two tubes. The stimulus from outside is introduced to the grid of the first tube through a transformer, as before, and the indicating instrument is again placed in the plate circuit of the first tube. The two plate circuits are in parallel with a common battery E, and the connections are such that the changes of P.D. between the anode and the filament of the first tube are imposed between the filament and grid of the second tube, and the changes of P.D. between the anode and filament of the second tube are imposed between the filament and grid of the first. In order to help to maintain the grids' advantageous potentials, grid leak resistances are connected as indicated.

The following numerical values are typical dimensions:—E=80 volts; $r_1=r_2=100{,}000$ ohms; $e_1=e_2=40$ volts. The sensitiveness of this relay could be made greater than that of fig. 1, when these large resistances are used.

The devices just described were the subject of a patent, numbered 10,290, 1918, taken out by the Admiralty, and the description is now published by permission.

Generating Oscillations by means of Thermionic Valves

By W. H. Eccles and F. W. Jordan. (*Abstract.*)

Section G.—Engineering.

In the typical method of using a three-electrode tube or "triode" for generating electrical oscillations, the connections are shown in fig. 1. The oscillations in the closed inductance-capacity circuit, sometimes called a flywheel circuit, are sustained by unidirectional pulses of current through the anode circuit, that is, through that external circuit of the tube which begins at a terminal of the filament and ends at the anode. This circuit includes a high-voltage battery, which is the ultimate source of the energy of the oscillations. The unidirectional pulses are produced in correct time phase by the action of the oscillations themselves on the grid circuit by means of the coupling between the coil in the closed circuit and a coil in the grid circuit.

When two or more triodes are used they are in the prevailing practice connected in parallel. It is known that unless special care is taken in selecting the tubes and in adjusting their normal grid voltages this connection does not in general give an output double that of a single tube. Moreover, if the coupling is made too close, as is often the case, the variations of the grid voltage may be so great as to carry the representative point in the characteristic diagram on to the straight horizontal parts of the curves, with the consequence that harmonics are produced, accomplished by a lack of symmetry in the oscillations generated.

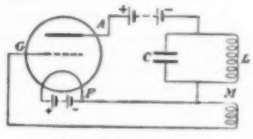


Fig. 1.

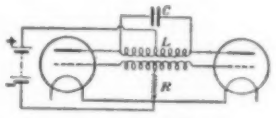


Fig. 2.

More symmetrical oscillations could be obtained if the flywheel circuit were acted upon by a triode and high-voltage battery symmetrically in every half period. The improvement to be described consists in arranging two tubes so as to fulfil the last stated condition. One way of doing this is to join the grids of the two tubes by a coil which is linked by means of its mutual inductance to the oscillating circuit. This method of joining the grids is shown in figs. 2 and 3. This mode of connection causes the potential of each grid, and therefore the resistance of each tube, to vary in opposite directions, that is, causes the resistance of one tube to increase, while that of the other diminishes—with a definite phase relation to the oscillations.

In fig. 2 the anode circuits of the tubes are in parallel and are connected in series with a high-voltage battery. They are associated with the flywheel circuit so that increase of one anode current applies to the flywheel circuit a stimulus in one direction, and increase of the other anode current applies a stimulus in the other direction. In the result the variations of both anode currents are effected in correct phase relation to maintain the oscillations of the flywheel circuit, an impulse

being applied first by one tube and then by the other in successive half periods.

In fig. 2 the coupling between the two anode circuits and the oscillatory circuit is direct. Fig. 3 shows a method in which the anode current acts by mutual inductance on the oscillatory circuit. In both figures R is a large resistance which acts as a grid leak and should be chosen so as to keep the grids at a voltage found advantageous by trial. A method

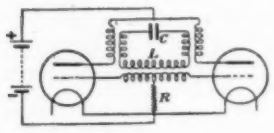


FIG. 3.

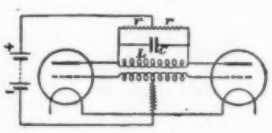


FIG. 4.

in which resistance coupling is employed is indicated in fig. 4. This has its advantages in certain laboratory applications. In fig. 5 a method employing condenser coupling is shown. Here again R indicates a grid leak. The condensers C_1 and C_2 need not be of any particular capacity; they are chosen by trial, and their variation has very little effect upon the frequency of the oscillations.

It is clear that instead of using two triodes, the symmetrical action could be obtained by using one tube possessing,

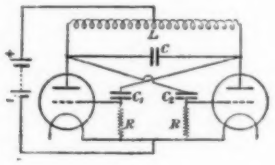


FIG. 5.

for example, a single plate, two grids and two filaments, or alternatively a single filament, two grids and two plates.

It is found that these cross-coupled circuits oscillate more freely than single circuits. They can be operated, for example, by using 4 or 5 volts only in the anode circuit with ordinary receiving B.T.H. triode valves.

The devices just described were the subject of a patent, No. 6,090, 1918, taken out by the Admiralty, and the description is now published by permission.

Wireless Navigation for Aircraft.

By CAPT. J. ROBINSON.—(*Abstract.*)

Section G.—Engineering.

The ordinary methods of navigation which are used for ships at sea are not sufficient for aircraft as the conditions of drift are of an entirely different order. It is thus necessary to use some other means for determining position in the air. Drift is of a very large magnitude in the air, and by night or in fog, it is very often impossible to apply dead-reckoning methods. The use of wireless bearings is the most hopeful method of progress, as with it bearings can be obtained with considerable accuracy.

The systems for determining bearings that were known at the beginning of the war were: (*a*) The single coil method. When such a coil is rotated about a vertical axis, the intensity of the wireless signal varies from zero to maximum, being zero when the plane of the coil is at right angles to the direction of the incoming waves. (*b*) The Bellini Tosi system, which uses two fixed-loop aerials at right angles to each other, the moving part being a small coil rotating between two coils at right angles which are in the circuits of the two fixed aerials. (*c*) The Telefunken clock.

There are two distinct methods of employing wireless bearings in order to determine position: By the first method the machine transmits, and each direction-finding station on the ground finds the bearing on the moving object, and communicates its bearing to a central station. There, the position of the moving object is worked out from the various bearings and retransmitted to it. By the second method the moving object has its own direction-finding apparatus and finds bearings on fixed transmitting stations.

As regards aircraft, method (*a*) was used largely by the Germans, and has considerable drawbacks. First, in case of war, when the aircraft transmits to ask for its position, this is also disclosed to the enemy. Second, only very few aircraft can be dealt with, as a considerable amount of transmission is required for a single aircraft to find its position. In consequence it was decided to attempt to use method (*b*) in the British air service.

It was found that considerable modifications to the known systems had to be applied. The single coil and Belfini-Tosi systems are what are called minimum systems, *i.e.*, in order to determine the bearing one finds the minimum by swinging the coil through this position until the signal is heard on both sides. On aircraft, as there is considerable extraneous noise, the region of this minimum is widened, and in consequence accuracy of the system diminishes. It is necessary to use a system where signals can be heard whilst the bearing is taken. The system devised is to use two coils at right angles which can be rotated together on a vertical axis. One coil alone is used first, and the system rotated to be somewhere near the maximum of this single coil. Then the second coil is introduced and its effects added to or subtracted from those of the first coil. If the first coil is correctly on its maximum then the second coil will be on its minimum, and thus there is no change of intensity on adding or subtracting the effects of this coil by a reversing switch. This method enables bearings to be taken whilst the signal is heard, and it can be applied to any system which has hitherto been a minimum system. Having devised this system there were other problems to be solved. One was to obtain efficient strength of signals. It was uncertain whether loops could be obtained of sufficient size to give loud enough signals to hear over the noise of the engine. The Bellini-Tosi system was considered to be too complicated, as at that time it was necessary to tune the two aerials to exactly the same frequency, and unless this system is very carefully installed fairly large errors are introduced.

It was hence decided to use the rotating aerial system. This was done in two ways. (*a*) Wing-coil system, in which the aerials are fixed rigidly to the aeroplane which has to be rotated in order to determine the bearing. This system is particularly useful in the case of flying towards an objective where there is a wireless station. (*b*) Rotating-coil system, in which the rotating coils are placed in the fuselage, and are rotated independently of the machine. This is particularly useful on the larger type of aeroplane, and enables position to be determined whenever a sufficient number of transmitting beacon stations can be heard.

Considerable difficulties had to be overcome to bring the R.A.F. system to a stage of perfection. Besides the extraneous noises on an aeroplane, there is a far greater disturbing influence due to the magneto, which produces considerable noise in the telephones, and cannot be overcome by amplification of signal strength. It is necessary to cut out this electrical disturbance, the cause of which was traced to the emission of very short waves by the magneto, the wave length being of the order of from 5 to 30 metres. It is possible to use short wave stoppers to cut out these waves, but by far the most efficient method is to screen the whole magneto system. When using the fuselage-coil system it was found that corrections had to be applied for the deviation produced by the metal work of the aircraft. These corrections can be determined by swinging the aircraft in a similar way to the swinging of a ship to adjust the compass.

In addition to the preceding difficulties there is another trouble in the variation of bearings produced by atmospheric influence. The extent of these variations is not large, possibly never more than about 3 deg. when using waves of 2,000 metres and upwards. The problem of this variation is one that should be investigated at an early date. The R.A.F. system of D.F. gives means for recording these variations very accurately. The sensitiveness of this system is under control and depends on the ratio of the area turns of the two coils. It is possible to design coils so that the system is sensitive to ¼ deg. This is the case when the minimum coil has its area turns about eight times those of the maximum coil. With such a system it is easy to conceive an automatic arrangement so that the variations in bearings can be automatically recorded.

Excellent results have been obtained with the R.A.F. system of wireless navigation. A large number of flights have been made, and it has been found that the mean error of bearing is 1¼ deg. when using beacon stations, whose distances vary from 20 to 500 miles. Under these circumstances when three beacon stations are available the mean error in determination of position was found to be seven miles.

Flights have been made purely by wireless navigation. One particular flight was made from Biggin Hill to Paris and back from Paris to Brighton. In both of these flights the machine was above the clouds most of the time. Position was determined by wireless bearings, and the course was set or altered from these determinations. The navigator was in a position so that he could not look out of the aeroplane, and he was able to determine the force and direction of the wind, and to forecast the time of arrival at his destination within two minutes.

Ignition of Gases by Hot Wires.

By PROF. W .M. THORNTON.—(*Abstract.*)

Section G.—Engineering.

This question is important where the possibility exists of inflammable gases coming into contact with incandescent wires, in coal mines or submarines, for example. From an examination of the behaviour of wires of platinum, nickel, iron, tungsten, molybdenum, gold, and silver heated by electric current in mixtures with air of hydrogen, methane, ethane, pentane, ethylene, methyl and ethyl alcohol, ethyl ether, benzene, coal gas and petrol, the following conclusions were reached: 1. The least igniting current is a linear function of the diameter of the wire. 2. Ignition is for a given size of wire independent of the calorific value of the gas. 3. It is independent of gas pressure down to a limit of about 10 cm. Hg, when it suddenly fails. Above atmospheric pressure it rises slightly. A platinum wire 0.02 cm. diameter ignites hydrogen (30 per cent.)

at 5.45 amperes at atmospheric pressure, and at 6 amperes at 100 lb. per sq. in. 4. Gaseous combination, which proceeds automatically to explosion, begins, in the case of platinum wires, with the wire at about 200 deg. C., well below red heat. 5. With an explosion vessel of 50 c.c. volume it is practically impossible to ignite methane by hot wires. Platinum wires glow white-hot and melt, but do not ignite the gas, which, on being tested afterwards with a spark discharge, immediately explodes. 6. Electric and magnetic fields have no direct influence on hot-wire ignition. 7. The temperature of platinum wires glowing brightly by surface combustion is, when measured by its change of electrical resistance, much lower than the apparent optical temperature. 8. Ignition is traced to an action occurring, if not within the surface layer of the metal itself, so close to it that the ordinary gas laws do not come into action. It is inferred that the mechanism of hot-wire ignition is an attack upon oxygen either within the wire or by positive ions of combustible gas ejected from it.

Heat Conductivity in Solid Insulators.

By Prof. W. M. Thornton, D.Sc., D.Eng.—(*Abstract.*)

Section G.—Engineering.

Thermal conductivity of metals has been adequately explained by the electron theory of matter. In the case of insulators the argument does not hold, and the mode of conduction in substances such as quartz or wax has not been worked out. There is a simple relation between the coefficient of thermal conductivity k, the density ρ, and the velocity of sound v, in a solid which throws much light on the process. It is that $k = v^3 \rho^2$, and since $v^2 = E/\rho$, where E is the elasticity, $k = E\rho$. These relations hold for all true solid insulators, but not for indiarubber or cork which have peculiar elastic properties. For example:—

Material.	Density.	Elasticity.	Velocity of sound.	Ep.	$v^2\rho^2$.	k.
Flint glass ...	2·9	$4·8 \times 10^{11}$	$4·1 \times 10^5$	14·1	14·1	14·3
Graphite ...	2·3	$5·25 \times 10^{11}$	$4·65 \times 10^5$	12·1	11·5	12·0
Paraffin wax.	0·91	$0·154 \times 10^{11}$	$0·13 \times 10^5$	0·14	0·14	0·141

From the kinetic energy of vibration $\frac{1}{2}mv^2$ it is found that the ratio of the velocity of sound to the velocity of atomic vibration by which heat is transmitted in insulators is 2.9×10^{10}. It is shown that the coincidence of this with v can be explained, and a reason given for the rule, $k = v^3\rho^2$ by simple electromagnetic consideration. The rule is a useful test for a heat insulator, the chief qualification is that it should be light and inelastic

Atmospheric Electricity and Terrestrial Magnetism.

By E. A. Reeves.—(*Abstract.*)

Section E.—Geography.

The experiments described in this paper resulted from investigations made in the subject of terrestrial magnetism, and appear to show that there is a more or less permanent static electric field in the lower atmosphere, with its lines of force connected with the rotation axis of the earth. The question of the possibility of a connection between this supposed field and the magnetism of the earth is raised. With a special apparatus it is shown that a strip of paper or other light material, when electrically charged and covered with a glass shade, coated with shellac varnish, will, if placed on a stand and set up on high open ground away from obstructions, come to rest within a degree or two of the true north and south points. In exceptional circumstances the line indicated is approximately at right angles to this line, that is, true east and west; but still the connection is with the rotation axis of the earth, and not with the magnetic meridian. Observations have been made in various parts for years past, and the results of some of these were shown at the meeting. The apparatus and method of using it were described, and the state of the atmosphere, localities, and other conditions under which the observations are likely to give the most satisfactory results were given in detail. When the indicator does not come to rest it continues to oscillate on either side of the true north and south points, and the mean of these is very nearly the line of the rotation or geographical axis. The principal object the author has in bringing the results of these observations to notice, now for the first time, is that they may induce others to take an interest in the subject, and continue experiments in other parts of the world. So far his own experiments have only been carried out in South-East England, but one or two friends have obtained much the same results in other parts of the country, and abroad.

Atmospheric Electricity.

One of the places of interest visited during the session of the British Association at Bournemouth was the small hut in Middle Chine where Dr. Mahomed has carried on observations on atmospheric electricity for the past seven or eight years. The Chines are rented by the Corporation, and are planted and kept up by it. The Council acceded to the doctor's application to set up a hut there for the purpose of these observations, and the Chine affords an excellent location for the purpose.

Dr. Mahomed showed the collector he used, which consisted of a small oil burner set in a double copper casing perforated with small holes in places which allowed the entry of air for combustion, but broke the force of winds so that the lamp could be used in half a gale without being blown out. The lamp is mounted on a bamboo pole and connected by a copper wire with an electroscope in the hut. The combustion of the oil (colza) ironises the atmosphere round it, and the intensity of the electrification is computed from the deflection of the gold leaf which moves over a scale. The lamp being of copper, becomes itself a conductor; it is insulated from the pole by an arm of ebonite, from which it swings; the fine copper wire from it joins a rod of copper which enters the hut through a window of ebonite, and connects with the electroscope. For convenience of observation the instrument is placed in a blackened box containing a mirror set at 45 deg. and a scale painted on ground glass, so that the position of the gold leaf on the scale is seen at a glance. At the other end of the hut is a copper rod some 8 ft. in length, balanced by weights, so that it can be projected through a hole in the roof. This rod carries a fuse of brown paper impregnated with saltpetre. When the fuse is lit ionisation takes place, and is measured also by the deflection of a gold leaf over a scale. The doctor explained that it was always well to check the two instruments one against the other, as defects of insulation due to dampness must always be guarded against, particularly in winter. Outside the hut he showed a portable instrument which he had designed and used. It was also a copper rod bearing a fuse. The rod ended in a bottle full of pitch and rubber and swung below a folding table; the rod being insulated by passing through a diaphragm of rubber inserted in the table.

Dr. Mahomed said that as far as he knew there were only three observatories in the kingdom where atmospheric electricity was recorded—Kew, Greenwich, and Eskdale Muir. From the point of view of meteorology there should be more. Early warnings of change of weather were often given by the electrical potential, especially local changes. From the point of view of climatology it was still more important. In the summer time business men in Bournemouth frequently slept in Swanage—'because it was more bracing.' Why was it more bracing? The sunshine, the rainfall, the prevailing winds must be the same. What was left? What our forefathers called telluric influences: which were bound up, in his opinion, with atmospheric electricity. He had tried to get simultaneous observations made in Swanage and Bournemouth, but it was difficult to find a qualified observer who had the leisure to make daily records. He had offered Trinity House to install an apparatus at the light house, but they did not even answer his letter. That was years before the war. There was no doubt that various features in the landscape of a health resort—a waterfall, a river, a mountain, a pine forest, and especially the geological formations—profoundly affected the local electrical conditions, and contributed to the beneficial effect of residence in such places. They ought to study these phenomena and not advise empirically.

While these remarks were being made a visitor had been watching the gold leaf; he now observed that the leaf, which had stood at about 20 degrees, equivalent to 550 volts, had dropped permanently to 10 or about 300 volts, and he asked if there was any explanation. There was bright sunshine at this time with a gentle breeze from S.S.W. The doctor pointed to the horizon. "You see that cloud out there. I think it has touched the sea and shorted the atmosphere. We shall have fog." By about 6 o'clock (*i.e.*, in two hours) there was a dry sea wrack all over the town and the air was chilly.

THE BRITANNIA ELECTRIC FIRE.

Recently we had the pleasure of viewing a new type of electric fire, designed to meet the needs of both home and foreign markets, recently developed by the Britannia Lamp and Accessories Co., Ltd. This fire, which we understand constitutes the first of a series of domestic devices being developed by this firm, embodies unique constructional features, resulting in an efficient radiant heater. Further, it has been produced in bulk, which makes it possible to offer it for sale at an extremely moderate price, within the means of the great majority of domestic users of electricity. In fact, the price is much lower than we have been hitherto accustomed to.

Our illustrations will give an idea of the appearance of these fires; fig. 1 shows the 3-kw. and fig. 2 the 2-kw. fire.

The Britannia fire is of extremely simple and robust construction, being built up of standard parts which can easily be replaced. It is fitted with one or more 1-kw. elements of special type, together with a high-class rotary switch and the necessary internal wiring. The connections between the elements and the flexible terminal are made by iron wire, the heat conductivity of which being low ensures the terminal and the flexible always remaining cool. Fig 3 shows the two heaters and rotary switch of a 2-kw. fire.

The element constitutes a departure from the usual practice, consisting of a brilliant reflector in the form of a metal trough, across the open curved front of which the heating spiral is carried, supported in position by small porcelain

distance pieces, fig. 4. With this type of element it is claimed that practically all the heat of the fire is radiated or reflected outwards, the porcelain parts being so small as to offer the minimum of interference with the heat rays. It should be noted that these porcelain pieces, owing to the construction adopted, are entirely free from stresses due to temperature or other causes, and even if broken through careless treatment, this would in no way interfere with the use of the element, which has been thoroughly tested in regular use over a period of three years. The curved front of the element diffuses

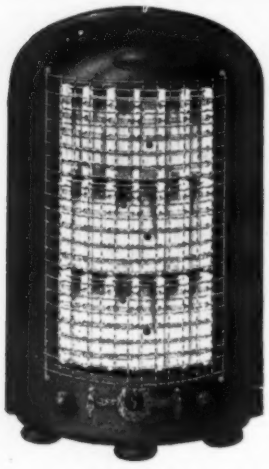


Fig. 1.—3-kw.

Fig. 2.—2-kw.

Britannia Electric Fires.

radiant heat over a larger area than would be the case with a flat element, and gives a greater side heating effect.

The fire is provided with a plain-pressed steel frame, finished in eggshell black with copper relief work, and, owing to its light weight, can be easily carried from room to room. It is supplied in single and multiple element sizes, the first element, in accordance with the I.E.E. regulations, being switched on by means of the wall-plug switch, while the remainder are controlled by a modern type of rotary switch fitted on the fire.

These fires are built in 1, 2, and 3-kw. sizes, for pressures of 100 to 250 volts, and can be supplied for higher voltages if required. The dimensions of the type F.B., 2-kw. fire are as

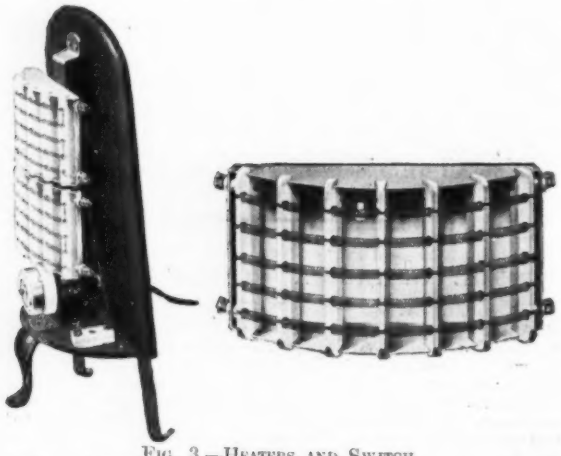


Fig. 3.—Heaters and Switch.

Fig. 4.—Heater showing Curved Front and Arrangement of Porcelains.

follows: height 19 in., width 12.25 in., depth 7.5 in., the weight being 8.5 lb. It will be noticed that there is an appreciable reduction in weight from the usual cast-iron type of fire.

If within two years from the date of purchase a Britannia fire becomes defective in respect of material or workmanship, the makers undertake to supply, free of charge, replacement for any part showing defect provided they are notified immediately the defect is discovered. Full instructions for renewing heating spirals or complete heaters are issued with each fire. Renewal is effected in the following manner: Three wing nuts are unscrewed at the back and the front of the fire taken off. Two small nuts on the heater are loosened with the spanner supplied and the wire spiral is withdrawn. The new spiral is mounted on the porcelains by passing the single stranded wires through the apertures in the porcelains, and thus the spiral is lead into its correct position as shown in fig. 4. Lastly, the straightened ends of the spirals are passed through porcelain insulators and between the washers and the nuts, the latter are tightened up and the cover replaced. To fix a complete new heater the nuts and wire connections are removed and the heater lifted off. A form of bayonet socket is provided so that the new heater cannot be fixed wrongly. Standard spare parts will be easily procurable, and the renewal of spirals or heaters can be made with no more difficulty than is encountered in the renewal of an ordinary gas mantle.

The Britannia fire will appeal particularly to shippers, as, owing to its construction, it offers exceptional facilities for economical packing. The carcases are built up of standard pressed-steel parts, bolted together, and when dismantled, similar parts can be packed together in nests, thus greatly decreasing the cubic space occupied, while the actual weight of the parts is, of course, negligible. The type F.B., 2-kw. fire when packed in sets of ten has the following cubic dimensions and weight: 5.19 cu. ft. or 0.17 cu. m. and 3 qrs. 1 lb. or 38.5 kilos, the latter being the net weight of the contents only. The dimensions of the space parts are as under:

	Length.	Width.	Height.	Net weight.
Spirals	9″	4·5″	0·5″	2 oz.
	22·9 cm.	11·4 cm.	1·3 cm.	57 grammes.
Porcelains ...	4·5″	2·5″	1·5″	10 oz.
	11·4 cm.	6·4 cm.	3·8 cm.	284 grammes.
Complete heating element ...	8·5″	4·5″	2·75″	16 oz.
	21·6 cm.	11·4 cm.	7·0 cm.	454 grammes.

Similar methods can be employed with the elements, the simple construction of which, as indeed of the complete fire, specially adapts them for rapid dismantling and assembly. The only parts of the fire susceptible to damage by careless handling are the porcelain distance pieces of the element, which, however, are small and inexpensive, and present no difficulty in safe packing when dismantled. Concise instructions for assembling these fires are provided in all cases where this is necessary.

AMERICAN EXPORTS OF ELECTRICAL GOODS.

The following figures, showing the exports of electrical goods from the United States during the year ended June, 1918, are taken from the recently-issued trade statistics; figures for 1916-17 have been added for purposes of comparison, and notes of any increases or decreases given:—

	Dollars. 1916-17.	Dollars. 1917-18.	Dollars. Inc. or dec.
Telegraph instruments.—			
To Denmark	17,000	1,000	– 16,000
,, Canada	50,000	69,000	+ 19,000
,, Central America ...	11,000	6,000	– 5,000
,, Mexico	14,000	3,000	– 11,000
,, Colombia	12,000	1,000	– 11,000
,, Argentina	5,000	—	– 5,000
,, Cuba	15,000	6,000	– 9,000
,, Brazil	9,000	7,000	– 2,000
,, Great Britain ...	94,000	37,000	– 57,000
,, Italy	141,000	9,000	– 132,000
,, China	15,000	—	– 15,000
,, Japan	26,000	41,000	+ 15,000
,, Other countries ...	—	114,000	– 16,000
Total	539,000	294,000	– 245,000
Telephone instruments.—			
To United Kingdom ...	51,000	117,000	+ 66,000
,, Canada	213,000	293,000	+ 80,000
,, Central America ...	13,000	76,000	+ 63,000
,, Mexico	19,000	38,000	+ 19,000
,, Cuba	190,000	85,000	– 105,000
,, Brazil	232,000	232,000	—
,, Colombia	20,000	6,000	– 14,000
,, Ecuador	21,000	1,000	– 20,000
,, Japan	148,000	187,000	+ 39,000
,, Australia	56,000	337,000	+ 281,000
,, Italy	230,000	154,000	– 76,000
,, Russia	246,000	18,000	– 228,000
,, China	117,000	94,000	– 23,000
,, Other countries ...	—	929,000	+ 531,000
Total	1,954,000	2,567,000	+ 613,000
Gas engines, stationary.—			
To Canada	63,000	63,000	—
,, Argentina	5,000	26,000	+ 21,000
,, Australia	66,000	52,000	– 14,000
,, Europe	335,000	172,000	– 163,000
,, Japan	23,000	61,000	+ 38,000
,, Other countries ...	249,000	189,000	– 37,000
Total	718,000	563,000	– 155,000

	Dollars. 1916-17.	Dollars. 1917-18.		Dollars. Inc. or dec.
Electric motors.—				
To France	387,000	305,000	–	82,000
,, United Kingdom ...	555,000	856,000	+	301,000
,, Canada	1,286,000	1,538,000	+	252,000
,, Panama	33,000	47,000	+	14,000
,, Mexico	107,000	162,000	+	55,000
,, Cuba	289,000	405,000	+	116,000
,, Argentina	104,000	265,000	+	161,000
,, Brazil	126,000	163,000	+	37,000
,, Chile	310,000	265,000	–	45,000
,, British India	114,000	296,000	+	182,000
,, Japan	195,000	469,000	+	274,000
,, Australia	720,000	340,000	–	380,000
,, South Africa	204,000	133,000	–	71,000
,, Russia-in-Europe ...	261,000	197,000	–	64,000
,, Italy	216,000	180,000	–	36,000
,, Spain	205,000	213,000	+	8,000
,, China	126,000	177,000	+	51,000
,, Other countries ...	778,000	588,000	–	64,000
Total	5,890,000	6,599,000	+	709,000
Other electrical instruments and appliances.—				
To Canada	5,298,000	4,584,000	–	714,000
,, Mexico	400,000	421,000	+	21,000
,, Panama	299,000	172,000	–	127,000
,, Cuba	981,000	722,000	–	259,000
,, Argentina	760,000	508,000	+	252,000
,, Brazil	715,000	492,000	–	223,000
,, Japan	1,019,000	1,296,000	+	277,000
,, Philippine Islands ...	146,000	105,000	–	41,000
,, Australia	821,000	422,000	–	399,000
,, United Kingdom ...	4,620,000	2,234,000	–	2,386,000
,, France	1,583,000	860,000	–	723,000
,, Italy	2,186,000	894,000	–	1,292,000
,, Norway	824,000	312,000	–	512,000
,, Russia	1,210,000	139,000	–	1,071,000
,, Chile	625,000	595,000	–	30,000
,, China	281,000	275,000	–	6,000
,, Other countries ...	—	1,990,000	–	779,000
Total	24,537,000	16,021,000	–	8,516,000
Arc lamps.—				
To Canada	4,000	5,000	+	1,000
,, Brazil	1,000	—	–	1,000
,, Other countries ...	11,000	8,000	–	3,000
Total	16,000	13,000	–	3,000
Metal-filament lamps.—				
To Russia-in-Europe ...	6,000	4,000	–	2,000
,, Russia-in-Asia ...	3,000	—	–	3,000
,, United Kingdom ...	15,000	4,000	–	11,000
,, Canada	461,000	804,000	+	343,000
,, Mexico	168,000	253,000	+	85,000
,, Cuba	273,000	416,000	+	143,000
,, Argentina	216,000	355,000	+	139,000
,, Brazil	265,000	441,000	+	176,000
,, Australia	83,000	98,000	+	15,000
,, China	90,000	27,000	–	63,000
,, Italy	31,000	24,000	–	7,000
,, Chile	93,000	183,000	+	90,000
,, Uruguay	54,000	60,000	+	6,000
,, Other countries ...	—	514,000	+	128,000
Total	2,144,000	3,183,000	+	1,039,000
Carbon-filament lamps.—				
To Argentina	7,000	1,000	–	6,000
,, Canada	87,000	94,000	+	7,000
,, Mexico	17,000	17,000		—
,, Brazil	5,000	5,000		—
,, Peru	8,000	—	–	8,000
,, Russia-in-Europe ...	18,000	—	–	18,000
,, Australia	6,000	—	–	6,000
,, Other countries ...	33,000	27,000	+	18,000
Total	157,000	144,000	–	13,000
Insulated wire and cables.—				
To France	1,965,000	796,000	–	1,169,000
,, Norway	463,000	157,000	–	306,000
,, United Kingdom ...	759,000	112,000	–	647,000
,, Spain	234,000	118,000	–	116,000
,, Canada	180,000	207,000	+	27,000
,, Panama	225,000	406,000	+	181,000
,, Mexico	189,000	215,000	+	26,000
,, Cuba	495,000	626,000	+	131,000
,, Brazil	571,000	716,000	+	145,000
,, Australia	73,000	203,000	+	130,000
,, Other countries ...	2,038,000	2,175,000	+	137,000
Total	7,192,000	5,731,000	–	1,461,000

	Dollars. 1916-17.	Dollars. 1917-18.		Dollars. Inc. or dec.
Static transformers.—				
To United Kingdom ...	13,000	2,000	–	11,000
,, Spain	39,000	74,000	+	35,000
,, Canada	220,000	238,000	+	18,000
,, Panama	15,000	52,000	+	37,000
,, Mexico	51,000	80,000	+	29,000
,, Cuba	103,000	133,000	+	30,000
,, Brazil	132,000	229,000	+	97,000
,, Chile	119,000	97,000	–	22,000
,, Japan	11,000	151,000	+	140,000
,, Australia	44,000	65,000	+	21,000
,, Italy	46,000	71,000	+	25,000
,, South Africa	41,000	50,000	+	9,000
,, Russia	136,000	76,000	–	60,000
,, China	57,000	40,000	–	17,000
,, Other countries ...	431,000	986,000	+	748,000
Total	1,265,000	2,344,000	+	1,079,000
Steam engines, stationary.—				
To Canada	195,000	364,000	+	169,000
,, Cuba	195,000	181,000	–	14,000
,, Mexico	23,000	44,000	+	21,000
,, Brazil	21,000	19,000	–	2,000
,, Philippine Islands ...	6,000	42,000	+	36,000
,, Russia	310,000	6,000	–	304,000
,, Chile	13,000	14,000	+	1,000
,, Australia	11,000	1,000	–	10,000
,, Other countries ...	485,000	271,000	+	120,000
Total	925,000	942,000	+	17,000
Electric locomotives.—				
To United Kingdom ...	15,000	8,000	–	7,000
,, Canada	208,000	68,000	–	140,000
,, Argentina	61,000	—	–	61,000
,, Mexico	11,000	10,000	–	1,000
,, Bolivia	2,000	—	–	2,000
,, Chile	182,000	23,000	–	159,000
,, France	49,000	—	–	49,000
,, Other countries ...	35,000	52,000*	+	17,000
Total	563,000	161,000	–	402,000

* Japan $18,000.

Dynamos and generators.—				
To Canada	426,000	441,000	+	15,000
,, United Kingdom ...	63,000	26,000	–	37,000
,, Panama	5,000	62,000	+	57,000
,, Mexico	51,000	60,000	+	9,000
,, Cuba	229,000	309,000	+	80,000
,, Brazil	29,000	57,000	+	28,000
,, Peru	53,000	10,000	–	43,000
,, Japan	245,000	367,000	+	122,000
,, Australia	88,000	104,000	+	16,000
,, Spain	107,000	21,000	–	86,000
,, France	160,000	444,000	+	284,000
,, Italy	291,000	30,000	–	261,000
,, China	222,000	126,000	–	96,000
,, Other countries ...	808,000	631,000	+	45,000
Total	2,555,000	2,688,000	+	133,000
Fans.—				
To Canada	97,000	131,000	+	34,000
,, Argentina	30,000	24,000	–	6,000
,, Brazil	6,000	15,000	+	9,000
,, China	33,000	116,000	+	83,000
,, British India	164,000	296,000	+	132,000
,, Japan	8,000	30,000	+	22,000
,, Australia	16,000	11,000	–	5,000
,, United Kingdom ...	21,000	4,000	–	17,000
,, Mexico	17,000	20,000	+	3,000
,, Other countries ...	108,000	171,000	+	80,000
Total	483,000	818,000	+	335,000

A Large Mill Motor.—One of the most interesting portions of the new plant in the Lake Michigan works of the Inland Steel Co., of Chicago, is the turbine and motor-room. According to the *Iron Trade Review*, in this room are installed two high-pressure steam turbo-generators, each with a capacity of 5,000 K.V.A., and generating at 2,200 volts. A remarkable feature is the motor and motor-generator for the 40-in. blooming mill. This set consists of a 3,000-H.P. induction motor, with a 45-ton fly-wheel and two D.C. generators, each of 1,450-KW. capacity. The motor for this mill is said to be one of the largest in the world. It has two separate and complete sets of winding; it is, in fact, two motors on the same shaft operating as one. The pressure across each is 600 volts, the two in series being double that. The combination worked as a unit is rated at 15,000 H.P. It will reverse from a speed of 40 R.P.M. in one direction to the same speed in the opposite direction in 90 seconds. The weight of this motor is 268 tons, the armature alone weighing 90 tons. Connection from motor to mill is by a universal joint.

FUEL ECONOMY IN THE MANUFACTURE OF IRON AND STEEL.

Abstract of report presented to the Iron and Steel Institute on behalf of the British Association Fuel Economy Committee by Prof. William A. Bone, D.Sc., F.R.S. (Chairman), Sir Robert Hadfield, Bart., F.R.S., and Mr. Alfred Hutchinson, M.A.

The British Association Fuel Economy Committee made, in the year 1916, detailed inquiries into the actual fuel consumptions in a number of British iron and steel works. The Council of the Iron and Steel Institute was good enough to offer to publish the results of the inquiry, and proposed that this report, together with other contributions, should furnish the basis of a general discussion upon fuel economy at the next autumn meeting. Dr. J. E. Stead was largely responsible for initiating the inquiry.

The main thesis of the report is that the achievement of the utmost fuel economy in a modern iron and steel works is essentially a matter of the scientific organisation and disposition of the plant as a whole, with a view to utilising to the best advantage, in the steelworks and rolling-mills, the energy in the surplus blast-furnace and coke-oven gases. For this has been shown to be sufficient, not only for converting molten iron from the blast-furnace into steel, but also for rolling the resulting ingots into finished steel sections.

The possibility of attaining such an ideal is primarily due to three great technical developments which have been made since 1880, namely:

(1) in the manufacture of metallurgical coke in chamber ovens with heat recuperation and by-product recovery;

(2) in the generation of power in internal-combustion engines from cleaned blast-furnace gas, the practical possibility of which was first demonstrated by the late Mr. B. H. Thwaite in 1894-5; and

(3) in methods of cleaning blast-furnace gas (*a*) by water-washing, as in the Thiessen apparatus, or, preferably, (*b*) by electrostatic methods, which have recently been developed in this country.

The British iron and steel industry has laboured under a disadvantage as compared with its continental rivals, for whereas most of our smelting plants and ironworks were established before 1880, the modern German industry arose after that period, when it was manifestly the right policy to organise and lay out iron and steel plants with the express purpose of securing all the advantages latent in such a concentration of units as has been indicated. During the decade preceding the war, whilst the newer German iron and steel works embodied, in a marked degree, the advantages of concentration and co-ordination of units, under scientific control, the older British plants had to be gradually remodelled, as circumstances permitted, so as to conform, as nearly as possible, to the new conditions.

We may feel warranted in regarding the consumption of no more than 1.75 tons of good coking coal per ton of finished steel sections produced as a "practical ideal" for a modern British plant.

By-product coke-ovens, blast-furnaces, steelworks, and rolling-mills must all be concentrated on one site, and suitably laid out in relation to each other. The by-product coke-ovens must be of the regenerative type, so as to yield the largest possible amount of surplus gas. The blast should be generated by means of a gas-driven blowing engine. The gases leaving the furnace should be dry-cleaned, preferably by some electrostatic method, so as to reduce their dust content to about 0.1 gramme per cubic metre. The hot-blast stoves should be heated by this dry-cleaned gas. The gas intended for generating power in gas-engines must be further cleaned until its dust content does not exceed 0.015 gramme per cu. metre.

The rolling-mills should preferably be electrically (not steam) driven. There must be scientific management and control throughout the whole heating system by properly trained fuel technologists, for it is essential that every available heat unit in the plant shall be tracked down and effectively utilised to the best advantage.

Taking a typical modern Cleveland plant, using 22.5 cwt. of coke per ton of pig iron produced, the heating value of the combined blast-furnace and surplus coke-oven gases per ton of iron is equivalent to 15 cwt. of the same coke, and (assuming a hot-blast stove efficiency of 75 per cent.) no more than 45 per cent. of the blast-furnace gas need be used for generating and heating the blast. The amount of heat in the surplus gases per ton of iron available for the steelworks power-house and rolling-mills would then be equivalent to that in about 8.5 cwt. of a good bituminous coal. Inasmuch as the average efficiency of gas-producers and boilers in steelworks is certainly not higher than 75 per cent., the effective coal equivalent of the surplus gases would be at least 11.3 cwt. per ton of iron produced at the blast-furnace, and, if properly utilised, this should be sufficient to meet all heat and power requirements in the steelworks and rolling-mills.

In districts such as Cleveland, where the smelting plants and steelworks are concentrated in a comparatively small area, the conditions are favourable to the success of "linking-up" schemes, as a means of realising more fully the benefits of the policy outlined in this report, by equalising the loads on the power-houses of the various plants during the working week. In this connection, the main transmission system of a public electric power company might be effectively utilised.

In the case of a Cleveland furnace making 1,000 tons of pig iron per week, and using no more than 22.5 cwt. of coke per ton (which means working under the best possible conditions), it can be shown that the total gas made per hour at the furnaces will be about 1,115,000 cubic feet at 60 deg. F. and 30 in. barometer. If this were electrostatically cleaned, and used to the best advantage on the plant, half of it should suffice to generate and heat the blast. The potential energy of the other half, if converted into electric power with an overall efficiency of 20 per cent., would be capable of developing 3,350 kw. continuously at the switchboard. The available surplus coke-oven gas would amount to a further 48,000 cu. ft. per hour, or sufficient to generate about 1,150 kw. continuously. Hence the total available power from the combined gases would be about 5,000 kw. continuously. This does not take any account of power derivable either from the stove waste heat or gas-engine exhausts, or yet of the heat carried away in the molten slag and iron, all of which might be turned to profitable use.

No doubt the best way of disposing of such surplus gas and waste heat would be to sell them to an electric power company for conversion into electricity. But if there is no power company near at hand to buy the energy, then it might be used to generate electricity for some electrochemical process, such, for instance, as (i) the manufacture of nitric acid from the air, or (ii) some electrometallurgical or electrolytic operation. What ought to be realised is that the combined by-product coke-oven and blast-furnace plant is not only an efficient producer of iron, but that it simultaneously, and of necessity, generates a most valuable "power-gas," of which the utmost use must be made in the interests of national economy.

From a mass of valuable data and information communicated by 25 firms to the committee, it is stated that the results, as a whole, prove beyond all question that much yet remains to be done before British iron and steel works will have attained to anything like the practical ideal of fuel economy which at least three leading iron and steel makers have declared to be even now attainable. The surplus blast-furnace and coke-oven gases can undoubtedly be much better and more fully utilised than they are to-day on most plants. The science of combustion is, as a rule, either imperfectly understood or very badly applied by those in charge of the plants. A great deal of heat can, and ought to, be recovered from such waste gases.

Such satisfactory progress is now being made with the electrostatic cleaning of blast-furnace gases, that the day may be confidently anticipated when all the gas (whether required for stoves or engines) will be so cleaned. This will undoubtedly increase the thermal efficiency of the hot-blast stoves, and make a larger surplus of gas available for the steelworks.

It seems a barbarous practice to burn uncleaned blast-furnace gas in Lancashire boilers, whose efficiency probably does not exceed 55 per cent., when (if cleaned) its potential energy can be transferred into electric power *viâ* the gas engine and dynamo. The day is fast approaching when, in steelworks adjacent to blast-furnaces, all stationary machines (including blowing engines, cranes, and rolling-mills) will be electrically driven by current generated from the explosion of blast-furnace gas in internal-combustion engines. Even now, steam-driven reciprocating blowing-engines should be superseded by electrically driven turbo-engines.

When such reforms have been carried out in connection with the blast-furnace plants, we may look for the abolition of the "gas-producer" in the adjacent steelworks, a step much to be desired. The blast-furnace is the place where all the coal on an iron or steel plant should be gasified after it has been carbonised in the coke ovens.

The problem of recovering and utilising the heat carried away in the molten slag from the blast furnace is one which ought to be solved in the near future.

The problem of fuel economy, as it presents itself to-day, is one rather of scientific organisation and co-ordination than of the discovery of new principles. In all the larger works there ought to be an organised staff wholly engaged, under competent direction, in controlling the fuel consumption. Such control ought not to be relegated to a member of the technical staff whose chief attention must be given to the supervision of machines or of operations in which the consumption of fuel is merely an incidental, and perhaps even subordinate, consideration. It should be borne in mind that our scientific knowledge regarding fuels and their combustion has developed so rapidly during the past twenty years that it has now become a separate branch of technology for which special training is required. Without such training the ordinary works chemist (and still more so the engineer) is not competent to handle the subject. The task of training a sufficient number of competent men is one that will tax to the utmost the resources of the various laboratories established within recent years for the special study of fuel technology at our universities, and the Government should be urged, as a matter of pressing and vital importance, to assist, by adequate financial support, the extension of such educational facilities. A great deal might also be accomplished by some co-operative

or collective effort on the part of a group of works in one and the same neighbourhood. Such group of firms might well unite in establishing, for their joint benefit, a common fuel laboratory and staff. The increasing cost of coal, and the present serious fuel situation, will probably compel action along some such lines.

The fuel situation has now become so serious in this country that the industry ought to cast aside sectional or individual interests or jealousies in a mighty and patriotic concerted effort to achieve the utmost efficiency and economy in its use of coal. It is a duty that it owes both to the present generation and to posterity.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Cost of Living in Burma.

Following on similar letters, it may be interesting to your readers to know what the cost and conditions of living are in Burma, and on what salary they should come out to the East.

Generally speaking, Burmese conditions are similar to those in India.

It will be information to many to know that a distinct social line is drawn between professional engineers and foremen, and therefore the salaries of the two vary somewhat.

A man in the latter class does not usually have a happy time, as he has to find his friends chiefly amongst the so-called Anglo-Indian, Anglo-Burman, or, in other words, the Eurasian element, with the result that he is made to feel an inferior person to those of the professional class out here in such a way as he never experiences at home.

A foreman's salary should not commence at less than Rs.400 per month, and he should have prospects of advancement up to Rs.750 per month; Rs.500 per month is little enough for him to marry on.

An Englishman who is a recognised club member, or, in other words, a professional man, should not come out at a salary of less than Rs.500 per month, and he should have prospects of annual increments up to Rs.1,000 per month; he will find difficulty in making ends meet at even Rs.750 as a married man.

He will also find that men of similar education and social standing in other branches of industry out in the East have salaries of from Rs.1,000 to Rs.3,000 after having been out here from 15 to 30 years.

Those leaving England on agreements should bear in mind that owing to their not being in a position to apply for and secure better appointments as they are able to in England; they are more or less obliged to stay with the firm that they first come out with, or, on the other hand, to return home.

Burma, *August 26th*, 1919. **G. Y. M.**

[Such letters as this are welcome, as the advice they contain is invaluable to men going abroad. We are always glad to receive such information from our readers in foreign parts.—Eds. Elec. Rev.]

Electric Soldering Irons.

We have read with interest Mr. Turnbull's article on page 295 of your issue of September 5th, on the above subject, and think a brief description of our standard soldering iron and automatic economy rack will interest him and other readers of your valuable journal.

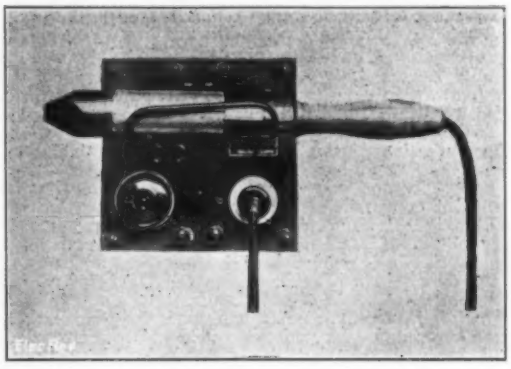
The advantages of an efficient electric soldering iron are many. To appreciate these advantages it is only necessary to watch a man soldering with an iron heated in a gas furnace. He heats his iron, takes it out of the gas furnace, cleans the tip, tins it, and then solders until the tip cools down to such a temperature that it fails to melt the solder, when he goes through the same process of reheating and cleaning. The time and labour used in cleaning and reheating the iron is spent on unnecessary work, and can be eliminated by using an electrically heated tool.

The electric soldering iron is clean, and remains clean. It is always hot, saving the delay in changing irons and stopping in the midst of soldering because the iron has cooled off. To be successful it should have the heating element hermetically sealed inside the body of the iron, to prevent moisture, solder, or flux coming into contact with the high-temperature wire. A tight joint or a brazed joint is not sufficient. It must be sealed in, and the same metal used throughout the structure, so as to secure perfect conduction of heat, and also prevent the seams or joints from opening up, due to unequal expansion.

Due to the high temperature at which it is necessary to work soldering irons when in service, troubles have been experienced due to the heating element burning out if left in circuit continuously, particularly if the iron is left switched on while not being used for soldering. This fact combined with the object of securing economy in energy consumption has led to the design of an automatic economy rack. The figure shows a standard soldering iron carried in this fitting.

The automatic economy rack consists of a slate panel, carrying on the back a resistance unit. On the front is mounted a cradle or hook, a switch controlling the supply, and a socket and plug to which a flexible to the iron is connected.

The weight of the soldering iron on the cradle opens contacts on the rear of the slate and inserts resistance in series with the iron. The resistance is of such a value that the watts consumption of the iron is reduced by about 30 per cent. when out of service. The temperature of the iron is



Soldering Iron on Economy Rack.

maintained at working heat, thus rendering it ready for instant use, increasing the output of work, and prolonging its working life.

The standard construction adopted for the iron heating element is as follows:—

The resistance element is of nickel-chromium wire with mica insulation wound over a cylindrical iron core. This core or stud is built with a shoulder and projecting end, which end has a very coarse thread to receive the copper tip. After the heating element is wound on the core and insulated with mica, a sheet-metal sleeve or casing is slipped over it. This casing fits very tightly, and comes flush with the shoulder, and the seam is acetylene welded; leads are carried back through insulating tubes inside this sheet metal casing to terminals carried within the handle of the iron.

The metal casing is reduced in diameter at the back of the heating element and is reinforced with ribs.

This construction has proved most reliable even under very severe service conditions, and, when it is used in conjunction with an automatic economy rack, reliability and economy are combined.

Igranic Electric Co., Ltd.,

London, *September 26th*, 1919. J. T. Mould.

Track Welding by the Metallic Arc.

The reason for the unfriendly attitude of Mr. E. Jacob in your issue of September 19th towards the article on the above subject is not clear, especially as this article is a result of observations made in the centre of a public thoroughfare in one of the "numerous towns in the country" where similar work may be seen on any fine day by anyone who so desires.

The analogy made by Mr. Jacob between the publication of observations made in the street and those made through unlawful entry to a works is very weak.

The criticism omits to state that about one month before this article was published the writer advised Mr. Jacob's firm that he "thought of offering an article to the technical Press" on this work. The reply received suggested that an interview would not be of any use, and asked him not to put their letters to any improper use. In accordance with this request no reference was made to their letters, and their name was not mentioned in the article.

As to any inaccuracy in details, the writer merely reported what he saw, and is not responsible for the extent these may have differed from the operators' instructions. Regarding costs, the bases of the figures are stated, and of course may be readily adjusted to suit varying conditions.

In conclusion, the writer thinks that to those interested in track welding the description given will be sufficient to indicate room for improvement, and hopes that the publication will assist in bringing the work to a higher state of perfection, and at the same time benefit the Rail Welding Co.

Cyril J. Hopkins.

Loughborough, *September 25th*, 1919.

Installation Material in Sweden.—A meeting of manufacturers of, and merchants in, the electrical installation and lighting glass branches was held at Stockholm a fortnight ago, when the scarcity of materials in these departments was discussed. The causes were attributed partly to the dearth of fuel which prevented the production of porcelain and glass, and partly to the non-arrival of imports which were expected from other countries.

ATOMIC SOURCES OF ENERGY.

In his address at the Watt Centenary Commemoration, Sir Oliver Lodge gave a lecture on "Sources of Energy," dealing throughout with radio-activity as a new source of energy of infinite possibilities. There was in nature, contained in the properties of matter, an immense source of energy which at present was inaccessible; but he saw no reason why the progress of discovery should not make it accessible. This was atomic energy, due to the structure of the atom itself. There was a vast store of energy there, and if they could utilise it on any extensive scale he suspected that the conditions of factory life would be greatly ameliorated. There would be no smoke due to imperfect combustion, and no dirt due to the transport of coal or ashes. The power would be very compact and clean, and there might occasionally be some explosions due to the liberation of power more quickly than it was wanted. But in general he supposed the conditions of utilisation would be good. At present they were at the beginning of the utilisation of the power. Radium disappeared as it gave off its energy, but the disappearance was so slow and the energy given off was so remarkable that during the disappearance of one grain of radium enough heat was given off to raise a ton of water from freezing to boiling point. The energy of radium was a million times that of the combustion of hydrogen. The combustion of hydrogen was under control, but the rate at which radium gave off its energy was not under control. A grain of radium might take a year or two to give off its energy. What happened was that now and then an atom fired off a projectile called an alpha ray. When it had fired off 65 "shots" radium had become common lead. There were many other radio-active substances, some much more energetic than radium, though therefore much more rare. One atom of radium out of 3,000 got into an unstable condition and fired itself off every year, so that the substance lasted a long time. The number of atoms, however, was so great that a milligramme—the 70th part of a grain—fired off thirty million "shots" per second. The speed of the "shots" was 1-15th that of lightning, which was why their energy was so enormous. A particle travelled 3,000 miles while a bullet travelled 300 yards. At present this energy was inaccessible. All forms of metal contained it, but some were quiet about it. The radio-active form threw it off spontaneously, not under stimulus. If they could find the stimulus, then would begin their utilisation of that source of energy, and if ultimately they were able to utilise—to extract and utilise mechanically—the whole of the energy in an ounce of matter they would find enough to raise the German Navy and pile it on top of a Scottish mountain—millions of foot tons per ounce of metal quite inaccessible. He hoped that the human race would not make the discovery until it had brain and morality enough to use it properly. If that discovery, made before its time by the wrong people, should get into the wrong hands, the very planet would be unsafe. If they liberated the atomic energy in large quantities the whole thing would blow up. Sometimes a new star appeared in the heavens. There was an explosion of terrific violence, but whether caused by the fact that some inhabitant "up there" had made a discovery or not he did not know. He believed they were on the verge of beginning to use a very minute fraction of the new energy. It was that energy which had made wireless telephony possible. Sir Oliver Lodge went on to describe by sketch and with much technical detail the theory on which wireless telephony is built up, the new energy being used to reinforce and amplify the electric current ordinarily produced. Thereby the faint reproduction of the sounds carried from the telephone to the receiver was magnified to an enormous extent. It might be said that by such a process the sounds would be so confused as to be unintelligible. If a mechanical relay were used, they would. They would not be able to stand that magnification; but when they were dealing with those particles which followed every fluctuation with the utmost ease—their speed being so enormous, their docility so great that they could follow every fluctuation of the pressure with perfect precision—there was no confusion. Articulation at the far end was perfectly satisfactory. The final amplifier spoke quite distinctly, be the distance 100 miles or 1,000 miles; by that method they could talk to America, and for a few hundred miles, at any rate, the articulation was perfect. It was in that way that wireless telephony had become possible, and a great deal more could be done in that direction. Even signals which could not otherwise be perceived might be perceived by that extraordinary power of amplification—the first solution of the utilisation of the atomic properties of matter.—*Birmingham Post.*

NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

22,609. "Telephonic arrangement for firemen." W. M. Burdon. September 15th.

22,622. "Reducing lagging current on alternating-current systems supplying induction motors, &c." H. A. L. Barry and A. M. Taylor. September 15th.

22,635. "Electric oven and shelving." A. Sciaroni. September 15th.

22,646. "Electrical indicators, &c." Edison Swan Electric Co. and J. C. Wrighton. September 15th.

22,655. "Protection of live rails or conductors in systems of electric traction." A. Raworth. September 15th.

22,686. "Apparatus for charging galvanic batteries." Oldham & Sons and G. Oldham, J. Oldham and O. Oldham. September 15th.

22,714. "Electric lamps for police, &c." Hiatt & Co. and A. D. Melson. September 16th.

22,715. "Starter for squirrel-cage induction motors." T. Takeuchi. September 16th.

22,725. "Electric-heating device for use with cooking-utensils, &c." S. L. R. Price. September 16th.

22,787. "Galvanic batteries." Oldham & Sons and G. Oldham, J. Oldham and O. Oldham. September 16th.

22,790. "Electric machines for high frequencies." A. M. Glass. (Lorenz Akt.-Ges C.) September 16th.

22,791. "Means for producing electric oscillations by electric arc." C. Lorenz Akt. Ges. September 16th. (Germany, June 5th, 1918.)

22,798. "High-speed electric locomotives." British Thomson-Houston Co. and F. W. Carter. September 16th.

22,863. "Electron discharge devices for wireless communication." J. Scott-Taggart. September 17th.

22,901. "Electro-magnetic switches." British Thomson-Houston Co. (General Electric Co.) September 17th.

22,908. "Electric switches." J. Roche. September 17th.

22,913. "Galvanic cells." K. Dukes. September 17th. (Austria, July 18th, 1918.)

22,914. "Windings for motors of electric dynamos." Schneider et Cie. September 17th. (France, June 10th.)

22,933. "Autoselective fuses." J. W. Taylor. September 17th. (United States, September 11th, 1918.)

22,960. "Negative and positive resistance vacuum-tube devices for wireless telegraphy." J. Scott-Taggart. September 18th.

22,961. "Electrical single and double preventer for exhaust openers and scutchers in blowing-rooms of textile factories." D. Walsh and A. Whipp. September 18th.

22,977. "Commutators for dynamo-electric machines." G. A. Jumlin and Metropolitan-Vickers Electrical Co. September 18th.

23,020. "Electric fuse holders." G. I. H. Davidson. September 18th.

23,038. "Combination of water turbine and water wheel for generating electricity, &c." J. Worthington. September 19th.

23,052. "Selenium cells." E. E. Fournier-d'Albe and Y. Hanman. September 19th.

23,057. "Method of driving electric generators on bicycles, &c." J. Earnshaw. September 19th.

23,069. "Electric signalling telegraph." W. F. Grafton and A. D. Jones. September 19th.

23,073. "Electro-medical or shocking coils." M. H. Goldstone. September 19th.

23,096. "Device for securing electric cables." Crompton & Co. and W. F. Jones. September 19th.

23,097 & 23,099. "Electric switches." Crompton & Co. and W. F. Jones. September 19th.

23,098. "Boxes for electrical apparatus." Crompton & Co. and W. F. Jones. September 19th.

23,097-9. "Electric switches." W. F. Jones. September 19th.

23,104. "Electrical dry battery." W. King. September 19th.

23,117. "Electric welding." F. W. Passmore. September 19th.

23,118. "Electric condensers, &c." G. F. Goldstone. September 19th.

23,120. "Electric switches." H. S. Cattermole. September 19th.

23,149. "Device for cleaning and priming sparking plug of internal-combustion engines." T. B. Broad. September 19th.

23,150. "Electric heating of water." S. H. Calvert. September 20th.

23,169. "Portable electric lamps." S. Riley. September 20th.

23,174. "Ignition attachment for prevention of theft of motor vehicles." T. A. Kirton. September 20th.

23,193. "Combined automatic switch or button for electric bell." D. Desplats. September 20th.

23,200. "Trolleys or current-collectors for electric trams, &c." T. J. Smeddles. September 20th.

PUBLISHED SPECIFICATIONS.

The numbers in parenthesis are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

8,883. Field magnets for magneto-electric machines. Evershed & Vignoles and S. Evershed. May 29th, 1918. (131,624.)

8,884. Electro-magnetic devices. G. Plaisant. May 29th, 1918. (131,625.)

10,676. Electrical apparatus for indicating and repeating movements at a distance. Schneider et Cie. February 13th, 1918. (131,635.)

10,816. Use for audion or lamp relay amplifying apparatus in telephony. M. Latour. June 30th, 1917. (Addition to 5,363/17.) (131,639.)

12,078. Valves of wireless transmission. Edison Swan Electric Co. and C. E. Hiatt. July 24th, 1918. (131,668.)

12,089. Manufacture of electric valve tubes for use in wireless telegraphy and the like. L. Rabinovitch and Cosmos Lamp Works. July 24th, 1918. (131,670.)

12,510. Valves for generating electric oscillations amplifying electric currents or rectifying electric currents. A. G. Bloxham. Russische Akt.-Ges L. M. Ericsson & Co.) July 31st, 1918. (131,680.)

12,750. Sparking plugs for internal-combustion engines. H. V. J. Jouffret. April 25th, 1918. (131,690.)

13,203. Apparatus for rectifying alternating current. M. Latour. August 14th, 1917. (131,697.)

13,282. Electric controlling device operable at a distance for the laying of artillery, projectors, range-finding apparatus, and other similar apparatus. Benard-Barbier & Turenne and E. Granat. August 15th, 1918. (131,699.)

13,369. Treatment of zinc solution, preparatory to the recovery of zinc by electro-deposition. Electrolytic Zinc Co., of Australasia Proprietary, Ltd. August 17th, 1917. (131,702.)

13,417. Telephone repeaters or relays. M. Latour. August 18th, 1917. (131,704.)

13,578. Automatic telephone systems. J. H. Taylor. August 21st, 1918. (131,707.)

13,791. Selecting switches such as are used in automatic telephone systems. Automatic Telephone Manufacturing Co. and J. Savin. August 24th, 1918. (131,716.)

13,874. Inverted incandescent mantles. C. W. Davis and Mantle Lamp Co. August 26th, 1918. (131,723.)

13,923. Electric transformers. S. Z. de Ferranti. August 27th, 1918. (131,725.)

13,986. Electric switches. C. R. C. Lyster, S. Russ and Newton & Wright. August 28th, 1918. (131,732.)

15,277. Electric accumulators or secondary batteries. E. J. Clark and Hart Accumulator Co. September 20th, 1918. (131,765.)

15,320. Electric furnaces. British Thomson-Houston Co. (General Electric Co.) September 20th, 1918. (131,767.)

17,217. Electric cell plates. T. Majima. October 22nd, 1918. (131,782.)

17,338. Alkaline electric accumulators. A. M. Cave. November 28th, 1917. (121,118.)

18,146. Sparking plugs and their manufacture. K. E. L. Guinness. November 5th, 1918. (131,792.)